PAVING AND MUNICIPAL ENGINEERING.

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

Published on the 15th of Each Month.

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OFFICE: ROOM 44, CHAMBER OF COMMERCE, - - - INDIANAPOLIS, IND.

Entered at the Post-office, Indianapolis, Ind., as second-class matter.

SUBSCRIPTION: { One Year, ... $1 00. Single Copy, ... 10.

FOREIGN SUBSCRIPTIONS.

Great Britain and Australia....6 s. sterling. | Austria.....4 florins.
France.....8 francs. | Germany.....6 marks.

Advertisements to insure publication should reach the publication office not later than the 5th of the month.

Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

Vol. II. INDIANAPOLIS, IND., APRIL, 1892. No. 11.

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The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

COMMENTS ON THE ASPHALT CONTROVERSY.

By W. H. Delano, Managing Director of the Compagnie Generale des Asphaltes de France, Paris.

THE letter in PAVING AND MUNICIPAL ENGINEERING for February, signed Julius Schubert, in which my name is cited, has evidently for its author the active and intelligent German engineer who managed the technical operations of laying, for the account of the Barber Company, the roadway of the Rue de Rivoli, Paris, during October and November, 1886, in de Smedts' patent bituminous mastic, sometimes, but most wrongfully, called "American Asphalt." I never had the pleasure of being introduced to Mr. Schubert, but he appears to know me, also my thoughts and motives. I most emphatically transverse his assertions, however, at the risk of being prolix.

This job in the Rue de Rivoli, between the Rue Cloche percee and the Rue Loban, was given to the Barber Company, not because the Compagnie Generale des Asphaltes would not lay it, being afraid of the tram rails (by our contract, we are bound to lay asphalt as ordered), but because: Firstly, the Barber Company had asked to make a trial of de Smedts' patent artificial compound in the Rue de Rivoli; secondly and chiefly, because the Barber Company's price of the new guaranteed work was 19 francs per square meter, including concrete, and 1 franc per square meter for the annual maintenance, whereas the price of the Compagnie Generale for eight-inch Portland cement, concrete and two-inch natural asphalt was 21 francs, and maintenance 2 francs.

Contrary to Mr. Schubert's assertion, I was most anxious to get the job, because the roadway above named was actually an asphalted job, but laid by a contractor who had gone bankrupt, and which was maintained by the Town of Paris as regards repairs.

There were also two existing lines of tram rails moulded on the longitudinal sleepers, reposing on a sand foundation; such lines always wabble, whereas the lines since laid have a cement concrete foundation, iron chairs well tied, so that the iron road is practically rigid.

Now, tram-car rails are disadvantageous to all roads, and particularly to those in asphalt, as there are ten longitudinal joints instead of the two along each road. Moreover, as the cars only cease running between 1 and 5 o'clock, A. M., repairs can only be done at night.

The general Paris Omnibus Company is responsible for repairs on each side the rail for a width of thirty-two centimeters or thirteen inches; the other two tramway companies, however, for a width of fifty centimeters or nineteen and one-half inches.

The Omnibus Company managed to get their responsibility commuted to paying a fixed annual sum of from $2.20 per running meter, which for one hundred meters run comes to 563.20 francs, an annuity worth having. This sum of $2.20 the Chief Engineer Monsieur Allard offered to me for the Rue de Rivoli, but the Barber Company's agent offered to take over the additional risk for nothing. So that the town having such pecuniary advantages all round with the Barber Company stopped negotiations with me.

On referring to Mr. Barabant's "*note sur les questions de viabilite*," page 9, A. D. 1884, I find the number of vehicles, mostly heavy, passing through the Rivoli street, in twenty-four hours, in 1881, was 42,035. This is the highest in Paris, and has no doubt increased since ten years ago. But we, the natural asphalt men were not dismayed; for we laid in the same Rue de Rivoli, beginning at the Rue Loban and reaching up to the Rue de Renard, just in front of the Hotel de Ville. There are no tramways here, but heavy three-horse omnibuses and other heavy vehicles are constantly passing, the drivers using their brakes freely, than which nothing is more destructive to roads of any kind.

Compressed asphalt is juxtadeposed to double tram rails Rue Solferino left bank of the Seine.

The Limmer Asphalte Company undertook the risk and got the extra $2.20 extra per running meter. The Compagnie Generale has done the same in a short street, Jean Tison, free.

Now, I see by the French and English letters patent taken out by Amzi Lorenzo Barber, in November, 1885, for what is called

therein "mastic litumineux" and "asphalte mastic," that the material is intended as a substitute for the products of bituminous calcareous rocks of Seyssel, Val de Travers, Brunswick, Sicily and other places.

Practically, the Barber Company said this to the Town of Paris: "We will lay down in your heaviest traffic street, the Rue de Rivoli, notwithstanding its double line of tram rails, an artificial mixture of sand, limestone, Trinidad pitch and petroleum, at the price 9½ per cent. lower than Delano for first cost, and 50 per cent. lower for annual maintenance."

It was a bold offer, perfectly clear as regards the issue, and, had it succeeded, would have well-nigh ruined the Seyssel mines, but the work failed most lamentably, not only in Paris, but also under similar conditions in the Landsberger Strasse, Berlin, as I saw with my own eyes.

In each case, the Barber Company had to take back the materials and never got a sou.

After this, a job they were to do in St. Martins' le Grand, opposite the General Postoffice, London, was dropped.

The honor of the Barber Company remained unsullied, they fought a losing game magnificently, but the loss could not have been less than 500,000 francs; great harm was done to the asphalt trade in Paris, and great encouragement to the unwholesome system of wood-block pavings.

I find in my diary that the Barber Company's job was begun in 1886, and after constant relayings, repairs by night and putting wood blocks along the rails, the public inconvenience was so great that it was entirely removed and replaced by wood, by August, 1887.

Natural compressed asphalt is always denser and harder at the surface than at the base; even when worn to one half inch, the phenomenon is perfectly observable. The more it wears the more it becomes compressed. Now, De Smedt imitated this peculiarity by using two bituminous mixtures. The bottom was made with coarse sand, called the binder or cushion, the top layer containing fine sand, for the wearing surface.

The Trinidad pitch, which contains in a raw state 33 per cent. of water and 33 per cent. of vegetable matter with fine clay, is carefully refined, leaving perhaps only 22 per cent. of clay and the mixture of petroleum, pitch, sand, etc., is effected mechanically, but after all, imitators always fall short, however intelligent.

The bitumen contained in the natural asphalt rock is chemically pure. Trinidad is impure.

The limestone itself is a fine oolite, and the impregnation so intimate, effected under conditions of heat and pressure only at nature's command, so that the material may be considered as one *sui generis* like coal, Roman cement, gypsum, antimony, granite, lava, etc., etc.

We natural asphalt men have always found that the presence of clay, pyrites, grit, or other extraneous matter, particularly light oils, is disadvantageous in compressed asphalt roads.

I know that artificial compounds will stand light traffic; there are court yards in Lyons made of asphalt, mastic, and grit, which have stood for sixty years, and the Claridge Asphalt Company has laid some in London made of Seyssel rock, at least forty years old.

But the hammering of horses' hoofs, the bumping of the wheels and of heavy vehicles driven at a rapid pace, and the slithering of the same when the brake is down, will soon reduce artificial compounds to their primitive elements, for they wear and tear the homogeneous natural material.

Now, as regards the nomenclature question: Asphalt has always been considered to be the limestone rock, naturally impregnated with bitumen, of which Seyssel is the type, and is a simple, short, convenient term for engineers and architects when drawing up their specifications in contradistinction to the artificial compounds of Trinidad pitch, petroleum, still bottom, gas tar, etc.

The Spaniards call the Trinidad pitch lake *La Brea*, the Spanish for pitch, as "*brai*" is the French for it, and the product is known as Trinidad pitch, and the concession as the Trinidad pitch concession—sometimes it is called by the Latin for pitch—*i. e.*, bitumen, but never asphalt.

It is only in the interesting reports of Captain Greene and in the Barber Company's catalogue, since they took over the "Grahamite" business, that we hear of Trinidad asphalt, an utter misnomer, and most confusing as well.

As Mr. Gibson says, the word is used in two different meanings, to the disadvantage of clearness and precision.

The divine command to Noah to pitch his ark within and without is translated in the Vulgate "Biluminabis" earn "bitumine;" the latter form is convenient as a verb and adjective. There is plenty of pitch—"slime," as the Bible calls it, in Asia Minor. The small Paris contractors call their gas tar "compound-asphalt" when they wish to defraud, or from the same weakness that makes the baker call himself a panificator.

Another expression which is faulty is that of "asphalt cement." In the building trade, cement is the powder made of lime and clay, which, when hydrated and mixed with sand and pebbles, makes concrete, but asphalt is a different material and represents a distinct idea—it is non-scientific as well as confusing to use such combinations of words. As the French say, "It is of no use to marry the carp and the rabbit."

Such expressions as "India rubber asphalt" "slate asphalt", "iron asphalt," "granite asphalt," are all anomalies, and should be discarded by practical men.

I do not understand why Mr. Malo's name is dragged in. Mr. Malo is a scientist and an engineer, who took up asphalt thirty-five years ago. He was engineer for the then only two really known asphalt mines, Seyssel and Val de Travers, both at that time in the hands of the Compagnie Generale des Asphaltes, and now directs the working of our mines at Seyssel (ain)—Mons (Gard) and Ragusa, Sicily, but he is no share-holder, and has the reputation of a highly honorable and impartial writer.

The Val de Travers mines belong to the Canton de Neufchatel and are leased till 1907 to the Neufchatel Asphalte Company, Lt., at which period they will, according to precedent, be put up to the highest bidder.

I have not the honor of knowing Mr. Gibson, who seems to be able to defend himself pretty well, but may say parenthetically, that no one has ever been paid by my company to belittle anybody.

During more than twenty years that I have invested my time and money in natural asphalt works, I have always tried to be a loyal competitor, and certainly after the kindness shown me in America by such honorable gentlemen as Mr. Barber, Captain Greene, Mr. Matt. Taylor, Dr. Filbert, and many others too numerous to mention, am not mean enough to inspire any writer to stab any American or other competitor in the back, and what I write myself I sign.

Mr. Julius Schubert must measure me in my own bushel—not in his or that of any other man, and his innuendoes do not touch me. This said without rancor or malice.

As regards slipperiness, natural asphalt is not slippery *per se* but it is smooth and so are the imitations; what causes the slipperiness is the greasy mud created by the rain falling on the surface dust and the remedy is to sprinkle fine sand over the surface, which material is always at hand in Paris streets, in sunk recesses or boxes; or, better still, to flush the road with water from the hydrants and get the squeegees to work. Naturally the horses can not pull a load up a smooth surface with a gradient of much more than 3 in 100.

TRINIDAD LAKE AND LAND PITCH.

BIDS submitted to the Indianapolis Board of Public Works on asphalt paving during the last month have brought about a controversy as to the relative merits of Trinidad lake and land pitch. The specifications called for standard Trinidad asphalt, and as two of the companies set up the claim that the other bidders were not prepared and did not intend to furnish standard asphalt, an inquiry into the quality of material became necessary.

It was asserted that the companies having the lowest bids intended to use Trinidad land pitch, which was inferior in quality to the lake pitch. Mr. Samuel Whinery, of the Warren-Scharf Company, explained to the board the differences between the two kinds of material.

He said that many experiments had been made with the "overflow" asphalt, but always with little or no success. Attempts had been made to make pavements from asphalt mined in West Virginia and Cuba, but they had failed. There was no material acceptable but the lake asphalt, and that was the kind used by his company. Mr. Whinery then described the asphalt lake on the island of Trinidad, and told how it is mined.

"The Warren-Scharf Company," said he, "bid only on lake asphalt. We have had as much experience as any company in the United States in making asphalt pavements, yet we would not attempt to make a good pavement of 'overflow' asphalt. We would not even bid on it if necessary, as one company seems to think."

Mr. Whinery then stated that the "overflow" had been used in Washington, Denver, Detroit and New York city, and had been discarded as of no account.

Mr. Whinery said if it could be shown that the competing companies having the lowest bids intended to use lake asphalt he had nothing to say, "but," he added "if they secure their asphalt from a company that imports land pitch, their bids should be excluded. With the best of asphalt it is difficult to lay a good asphalt pavement. Two of the companies bidding here have never laid a yard of asphalt pavement; with poor material it would be hard for them to avoid a failure."

Mr. V. W. Foster, president of the Western Paving and Supply Company, submitted a written statement, in which he said:

"There are but two kinds of asphalt imported from Trinidad. The names or designation of kind given these two kinds are first, Pitch lake asphalt, meaning asphalt mined directly from Pitch lake; second, 'land pitch,' or 'overflow,' which is mined in the Island of Trinidad outside of Pitch lake. One of our bids was based on the idea that the first of these kinds was to be used. The other bid was for the second kind. It will then appear that we have bid on all the kinds imported and in the market. It only remains, then, for the board to decide which of these two kinds is 'commonly known' as the 'best quality of Trinidad asphalt.' If it is decided that 'land pitch,' or 'overflow,' will meet the specifications and be satisfactory to the board, we insist that we are the lowest bidders on all the streets, save Virginia avenue. If it is decided that 'Pitch lake' asphalt is the kind of material that meets the specifications, then we are the lowest bidders on all of the work until other bidders satisfy the board that they have a proper supply of Pitch lake asphalt.

"We herewith hand the board an affidavit of George Christall, importer, showing the source and duration, quantity and quality, of our supply. Unless our competitors will come and show to the board that they have a contract for a supply of 'Pitch lake' asphalt, we offer now and will give bond to show that the 'land pitch,' or 'overflow' asphalt, bid on by us, is equal in every respect to the so-called 'best quality of Trinidad asphalt' bid upon by our competitors, measured by any standard which will determine the relative quality."

State of Indiana, County of Marion, ss.:

George Christall, of lawful age, being duly sworn, on oath says that he is the president of the Trinidad Asphalt Paving Company of New Jersey; that he has resided in the Island of Trinidad for a period of five years, and is thoroughly conversant with all of the deposits of asphalt found on the island, and is the owner of large deposits of asphalt on the island, and is an importer of both "Pitch lake" asphalt and "land pitch," or "overflow," asphalt, these two kinds being the only kinds of asphalt exported from the island; that the "Pitch lake" is owned by the government of the Island of Trinidad, and is leased by the government for a period of forty years to parties known as the "concessionaires;" that affiant, as president of the Trindad Asphalt Paving Company, has contracted for an unlimited supply of asphalt from said Pitch lake covering the period of concession, and that said Trinidad Asphalt Paving Company has contracted with the Western Paving and Supply Company to furnish said company all the Pitch lake asphalt they may require; which said contract has twenty-seven years yet to run. Also, for whatever "land pitch," or "overflow," they may require for the same period. GEORGE CHRISTALL.

Subscribed and sworn to before me this, the 28th day of March, 1892. GEORGE P. ANDERSON, Notary Public.

At this point Mr. Christall, president of the Trinidad Asphalt Importing Company, of New Jersey, was introduced by Mr. Foster, and asserted himself in readiness to answer any questions that might be asked about the two kinds of asphalt. Mr. Christall owns large deposits of "overflow" asphalt on the Island of Trinidad, and imports the lake asphalt. He said he could make more money selling the "overflow," but he could not recommend it, as it is an inferior quality of asphalt. He always notified his customers that if they bought the "overflow" it was at their own risk. President Conduitt then asked Mr. Christall a few questions in order to ascertain whether or not a monopoly controls the output of lake asphalt. He replied that Barber & Co., the Warren company, the Cranford company, the Trinidad Asphalt Company, Filbert & Co., and the New Orleans company imported the lake asphalt, while Carter, Hawley & Co., the West Indies Company, the Standard Asphalt Company and others imported the "land pitch." He explained the inferiority of the latter from the fact that it is deficient in asphaltic oil.

Mr. F. H. Blackledge, representing the firm of Fulmer, Seibert & Co., the lowest bidders, insisted that his clients were in exact and literal compliance with the specifications, ready to use the "best quality of standard refined Trinidad asphalt," and to give bond for the performance of the work. He claimed that there was a monopoly on lake pitch, and that outside companies could not get it, though the one he represented was ready to buy all necessary for its contracts at $40 per ton, which was higher than the commercial value. The board, however, rejected the bid, and finally reached the conclusion, after hearing the question discussed in secret session, that in the future it would require that all contracts for asphalt paving shall specify the Trinidad lake pitch.

To the Editor of Paving and Municipal Engineering:

SIR—On my return to New York yesterday, a copy of the *Indianapolis Journal* of Tuesday morning, March 29th, was handed to me, in which I found marked an article "The Two Kinds of Asphalt." The article is a report of the meeting of asphalt paving men with the board of commissioners of public works of the city of Indianapolis, and would be highly amusing if the object to create wrong impressions in the minds of the commissioners and the people was of less serious nature.

A determined effort by a strong monopoly, the existence of which can be substantiated beyond the least doubt, by sworn statements, has been made for the purpose of keeping honest competition out of Indianapolis, and the statements which were made in the article referred to, if not based on ignorance, are misrepresentations.

To what Mr. Whinery had to say, very few objections can be made, except that he wished to make a wrong impression on the board with his remarks, "Our company would not attempt to make a street of land pitch at any price." The statement is calculated to impress the board of commissioners with the idea that he considered the asphalt outside the lake so poor as to be unfit for paving purposes. That good pavements can be laid, and have been laid to the satisfaction of all concerned, in every respect just as good as any Lake asphalt pavements, with the Pitch Point asphalt of Trinidad, the Warren-Scharff Company knows better than any other of the asphalt paving companies. Mr. Whinery should not judge the character of the asphalt outside the Pitch lake by the pavements which have been laid by the Western Paving and Supply Company with asphalt furnished by Mr. Christall's company, "The Trinidad Asphalt Paving Company," of New York, because, as I shall show hereafter, their asphalt has not been refined according to the best and most approved method, and has undoubtedly been laid in Indianapolis without adequate expert knowlege or skill. If he had only the latter pavements to judge from, his wholesale

condemnation would be justified. If Mr. Whinery claims that failures in pavements have been made with West Virginia asphalt he must certainly be in error, because the Ritchie mine, the only asphalt mine in West Virginia, was exhausted in the year 1872 at a time when little or nothing was known in the United States about asphalt pavements. Mr. Whinery acknowledges that chemists can't find any difference between the two asphalts, and I will say, neither can any one who does not wish to misrepresent matters. I have worked both kinds of asphalt in their refined state and know the characeristics of the crude material, and know therefore, of what I speak: and will, further on, come back to that subject.

The name of "overflow asphalt" is a misnomer and has been invented for the sole purpose of checking or killing off competition. As far back as the year 1860, English geologists in a report to the British Crown say: "All previous descriptions refer to the bituminous material scattered over the La Brea district, and especially between the village and lake, to streams which have issued at some former epoch from the latter and extended into the sea. This supposition is totally incorrect, as solidification would probably have ensued before it would have proceeded one-tenth of the distance, and such of the asphalt as undoubtedly escaped from the lake has not advanced more than a few yards, and always presents the curved surface already described, and never appears as an extended sheet. These bituminous masses or layers are too intimately associated with the soil and sub-stratum to have been derived from any foreign source."

In speaking of the LaBrea district, all of which produces asphalt, and of which the lake forms less than the thirtieth part, the same authority says: "Springs of asphaltic oil or petroleum are abundant; these often collect into pools forming deposits of what is termed liquid pitch. In consequence of the plastic nature of the ordinary bitumen already alluded to, it invariably yields to pressure until a new equilibrium is established; thus, where houses have been erected on a strata containing a bituminous laminæ or masses, the additional weight displaces the latter, the foundations give way, the buildings diverge from the perpendicular and their stability is endangered. Similarly where excavations have been opened in the solid asphalt, the pressure of the sides forces up the center and the cavity speedily closes up. This explains the continuous renewal at the surface, since, of course, it is only subsequent to the formation of the asphalt that the property of susceptibly to pressure is assumed.

"LaBrea Point is lined with masses of asphaltum, and, as already stated, wherever a free and exposed surface exists the substance exudes from the interior and collects on the surface.

"The consequence then to which we are conducted by the above facts is, that where a stratum highly charged with bituminous matter occupies a section of the country portions of the asphalt appear on the surface either in extended sheets or in detached pieces, as in the gardens of LaBrea village, or in larger masses, as at LaBrea Point, where they protrude for some distance into the sea."

LaBrea Point above referred to now appears upon the maps of the island as Pitch Point.

The whole section of the country near Pitch Lake and Pitch Point in Trinidad is underlaid with asphalt for about 3,000 acres, all having the same source and the same characteristics. Whenever the "Pitch Point" asphalt is refined with the same care as the Warren-Scharff Co. bestows on the lake asphalt the results are equal, and the pavements laid with either asphalt are good and lasting. I am perfectly familiar with the method of refining at the Warren Chemical Works in Long Island City, and I must say that great care is taken to produce a good refined article. But, as Mr. Whinery says, "It is every thing to know how;" without the knowledge of that "how" failures in pavements will be made.

I will now give my reasons why the refined asphalt used by the Western Paving and Supply Company, under its method of refining, is not, never was, and never will be the best quality of Trinidad asphalt, as long as the crude material is refined under the patent process which is used by the George Christall Company—the Trinidad Asphalt Paving Company—from whom the Western Paving Company get their supply. The third claim in this patent reads as follows: "The process of refining crude asphaltum, which consists in subjecting the same to a temperature of from 250° to 300° Fahrenheit and simultaneously passing through it a current of air, said air being admitted at or near the bottom or hottest portion of the charge, whereby it is suddenly expanded," etc.

This passing of the current of air through the hot asphalt, for days and days, plays the mischief, by oxidizing the material, and if continued long enough will make the asphalt totally unfit for paving purposes. It makes no difference if the crude asphalt came from Pitch Lake or Pitch Point; if it was "lake," "overflow," "land pitch" or "Point pitch," or any other kind of pitch.

I have experimented long enough to know this to be a fact, and I consider even the agitation with air, usually practiced after oiling, detrimental, and should be, if not totally abolished, done very sparingly.

The air makes the asphalt brittle, and if pavers use such asphalt, and prepare the asphalt-cement mixture in the usual way, at the same time using a poor residuum oil, the pavement laid will have a very short life. It will powder and have none of the curative qualities which good Trinidad asphalt pavements possess.

Mr. Christall claims that the chemical analysis shows a difference in the composition of the two asphalts. Mr. Whinery says, in regard to the chemical analysis, the two kinds are similar.

Mr. Christall claims also that the bi-sulphide of carbon test is the only test. If he relies on this test alone there is no wonder his company sends such poor refined asphalt into the market, which is bound to create failures.

The chemical analysis tells the paver there is so much mineral or vegetable matter in the asphalt, and so much bitumen soluble in bi-sulphide of carbon. So far, so good. But it does not tell the paver if the bitumen found in it is good for paving purposes or not; the knowledge of the last is the most important for the paver.

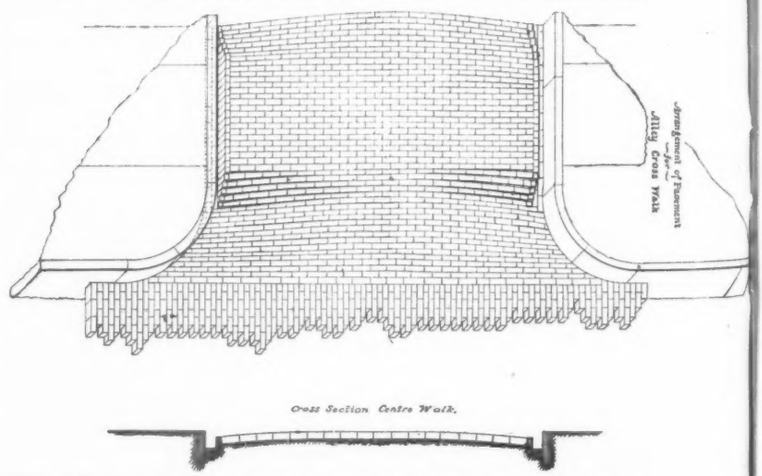
For my part, I have not found any difference in the asphalts coming from Trinidad, and all that Prof. Bowen claims is about 2 per cent. less bitumen in what he calls the overflow. It is possible the Professor may have had a poor specimen. JUL. SCHUBERT.

CROSS-WALKS FOR BRICK STREETS.

By M. R. Sherrord, C. E.

IN the construction of brick streets, and, in fact, in all pavements, it is essential to provide cross-walks at the street and alley intersections.

In the accompanying sketch, the construction of a cross-walk



applicable for the large size brick blocks is given. The sketch shows the method as applied to alley crossings, where the surface water drains from the alley to the street. The same arrangement is useful for street intersections.

Two courses of brick are laid parallel with and next to the curb on the grade of the gutter, then a row of blocks on end rising gradually from the grade of the gutter at the side of the cross-walk,

to a height of one-half or more of the depth of gutter, above the gutter, at equal distances from the center of the cross-walk, such distance depending on the width desired for the walk. The walk is then laid from the pavement grade, or a little above the pavement grade, at the center of the street or alley with a gradual roll from the regular pavement to the row of "headers" above described.

A practical paver can lay such a walk without the inequalities which show in the sketch (on account of the oblique projection and distorted elevation) being apparent in the finished work. Where 4-in.x5 in.x12 brick blocks are used, the row of "headers" should be placed with their 4-in. face next to the curb.

This construction has been in use on some of the brick streets of Peoria, Illinois, and gives excellent results. The advantage over the former method of giving the pavement a slight roll except at gutters where aprons were used is, it keeps the walks drier, confining the water to the gutters and bringing the cross walk nearer the grade of the sidewalks, and in doing away with the aprons.

This construction for cross-walks is not new, but its application to brick streets seems advisable to me and I present it for consideration.

RESISTANCE TO TRACTION ON ROADS.

RESISTANCE to traction is known to be nearly proportional to the weight. S. C. Thompson, of New York, in his prize essay on roadmaking, says on this subject:

"It increases on paved roads with the velocity, owing to the increase of concussions, but it remains nearly constant on roads with a compressible surface, as earth, sand or turf (Rumford & Morin). The smoother the pavement and the less rigid the carriage—*i. e.*—the better it is hung—the less does the velocity affect the resistance.

"Whenever the velocity is not above a pace, springs do not affect the resistance; when it is greater, the resistance decreases as the carriage is better hung. On soft roads springs may slightly increase the resistance at low speeds. The destruction of the road and carriage is greater when the latter is without than with springs (Morin).

"The advantages of a paved over a macadam road in point of traction, are considerable for heavy loads, less for stages, and nearly nothing for light carriages (Debaune).

"According to Morin, the resistance to traction increases slightly with the number of wheels, but is inversely proportional to their diameter. According to Dupuit it is inversely as the square root; according to Clark, as the cube root of the diameter. The destruction of the road and the carriage is always greater as the diameter of the wheel is less (Morin).

"On a paved or hard macadam road the resistance is independent of the width of the tire, when this quantity exceeds about 4 inches (Dupuit and Morin). When it is between 2 and 4 inches for heavy loads and low speeds, the broader tire will give proportionately less resistance. For light loads the width has no influence on the resistance. On earth and other compressible roads the resistance increases inversely as the width of the tire (Rumford and Morin). In Europe a common rule is to make the width of a tire one half an inch for every 125-175 pounds upon the wheel, according to the character of the roads. The least width is usually about 2 inches.

"From the above we may gather that the most economical conditions for traction are:

"1. A hard and smooth surface, both when speed is to be attained and where heavy loads are to be hauled, and

"2. Large wheels, especially for heavy loads.

"3. For light loads the width of tire is immaterial, and is therefore better as narrow as the character of the road will permit. For heavy loads, the resistance increases inversely as the width of tire. While on hard roads this effect is less, it is very decided on soft roads. The width should not exceed 4 inches at least on hard roads, and it is rarely less than 2 inches, except for light pleasure carriages.

"Easy springs not only act preservingly on roads and carriages, but materially decrease the resistance of traction at trotting or running speeds.

"The following table presents the results of experiments on the resistance of vehicles to traction or different classes of roads. The fractions which are generally rounded off, indicate the part of the whole weight, which is equivalent to the resistance of drawing it on a level road. An examination of this table will clearly show the great economy in horse-power by using the hardest and smoothest roads. For instance, if one horse can just draw a load on a level road on iron rails, it will take $1\frac{2}{3}$ horses to draw it on asphalt, $3\frac{1}{3}$ on the best Belgian block pavement, 5 on the ordinary Belgian pavement, 7 on good cobble-stones, 13 on bad cobble-stones, 20 on an ordinary earth road, and 40 on a sandy road.

Character of Road.	Resistance in Terms of Load.	Velocity.	Authority.
Sand	$\frac{1}{2}$	Pace	Bevan
Sandy Road	$\frac{1}{3}$	3′ 12″ per sec	Morin
Loose Gravel	$\frac{1}{4}$	Pace	Bevan
Gravel, 4 inches thick	$\frac{1}{10}$	Pace	Morin
Common Gravel Road	$\frac{1}{16}$	Pace	MacNeil
Gravel Road	$\frac{1}{20}$	3′ per sec	Rumford
Gravel Road	$\frac{1}{25}$	12′ per sec	Rumford
Hard Rolled Gravel	$\frac{1}{30}$	Pace	Bevan; Minard
Wet Turf	$\frac{1}{8}$	Pace	Morin
Hard and Dry Turf	$\frac{1}{18}$	Pace	Morin
Hard and Dry Turf	$\frac{1}{25}$	.....	Bevan
Ordinary Earth Road	$\frac{1}{10}$	Pace	Bevan
Hard Clay	$\frac{1}{20}$	.....	Bevan
Hard and Dry Earth Road	$\frac{1}{22}$ $\frac{1}{30}$	Pace	Morin
Ordinary Cobble-stone	$\frac{1}{8}$	Trot	.....
Ordinary Cobble stone	$\frac{1}{7}$	Pace	.....
Good Cobble-stone (3½-inch)	$\frac{1}{16}$	Trot	Kossack
Good Cobble stone (3½-inch)	$\frac{1}{15}$	Pace	Kossack
Good Carriage with Springs)	$\frac{1}{30}$	Pace	Kossack
Macadam little used	$\frac{1}{25}$	.....	Morin
Bad Macadam	$\frac{1}{16}$ $\frac{1}{23}$	Pace	Gordon
Old Macadam	$\frac{1}{14}$	.....	Navier
Ordinary Macadam	$\frac{1}{25}$	Trot	MacNeil; Perdont; Kossack
Ordinary Macadam	$\frac{1}{30}$	Pace	
Good Macadam (wet and slightly muddy)	$\frac{1}{30}$ $\frac{1}{45}$	.. ..	Morin
Best French Macadam	$\frac{1}{30}$	.....	Navier
Very hard and smooth Macadam	$\frac{1}{50}$	.. ..	MacNeil
Best Macadam	$\frac{1}{35}$	Trot	Rumford
Best Macadam	$\frac{1}{45}$	Pace	Rumford
Best Macadam	$\frac{1}{46}$ $\frac{1}{60}$	.....	Gordon
Best Macadam	$\frac{1}{43}$ $\frac{1}{70}$	.....	Morin
Ordinary Stone Block	$\frac{1}{25}$	.....	Perdont; Poncelet; Minard
Ordinary Belgian Block	$\frac{1}{40}$	Pace	MacNeil
Good Stone Block	$\frac{1}{17}$	Trot	Rumford
Good Stone Block	$\frac{1}{30}$	Pace	Rumford
Belgian Block, Boulevard, Paris	$\frac{1}{45}$ $\frac{1}{66}$	.....	Navier
Good Belgian Block	$\frac{1}{30}$	Trot	Rumford
Good Belgian Block	$\frac{1}{60}$	Pace	Rumford
Good London Block	$\frac{1}{62}$	.....	Gordon
Well-laid Belgian Block	$\frac{1}{65}$	... .	MacNeil
Good Belgian Block	$\frac{1}{45}$ $\frac{1}{87}$	.....	Morin
Planked Roadway (bridge)	$\frac{1}{40}$ $\frac{1}{57}$	.....	Morin
Asphalt	$\frac{1}{133}$	.....	Gordon
Granite Tramway	$\frac{1}{166}$	.....	Gordon
Iron Tramway	$\frac{1}{200}$	.....	Gordon
Sleighs on snow, 3 inches thick, ¾-inch runners, temperature 26 degrees	$\frac{1}{30}$	.....	.....

THE ROADS OF PENNSYLVANIA.

By F. F. Weld.

IT is said that the civilization of a country is marked by its roads. If this be true Pennsylvania can by no means claim the highest rank. Ex-Governor Beaver is authority for the statement that probably no other expenditure of public moneys yields so little in return as that of the road taxes of this commonwealth. What is the cause of this state of affairs? and what can be done to improve our bad roads? are the questions that naturally arise.

One of the chief causes is the present system of legislation upon the subject. Although our present laws answered their purpose when framed fifty years ago, their days of usefulness are passed. We now need something very different.

The old system of "working out" the taxes should be abolished. Under it but little work is done, and that under the direction of a man who has no knowledge of practical road-building. It would show as good sense to put a mechanic in charge of a farm as it does to put the average road commissioner in charge of our public highways.

The entire road system should be under the direction of competent civil engineers who understand economic road construction. The present office of county surveyor might be filled by an experienced engineer who should have charge of the roads, they being

directly cared for by assistants who should refer all important questions to the engineer.

Moneyed tax should be collected, of which not less than twenty-five per cent. should be expended in making permanent roads, of kinds varying to suit the varied conditions of different sections of our commonwealth.

Let every kind of property bear its share of the expense of

keeping up the roads, instead of compelling real estate to bear almost the entire burden, for the condition of the roads affects seriously the value of the farmer's produce, and thus, indirectly, all classes of people.

In considering what can be done to improve our roads, let us see what a good one should be.

Since the cost of surveying for a new road is but a small part of its ultimate cost, and since upon the choice of the best route very largely depends the ultimate cost and usefulness of the highway, no effort should be spared to determine the best location. The object of a road is directness, safety, and economy of carriage; hence, the first thing to be considered is its alignment. As every increase in length means a corresponding increase in the cost of building, in the expense of repairing, and a loss in time and labor expended in traveling it, other things being equal, the road should be straight. This does not necessarily mean that it must pass over a hill rather than around its base, for often the one route is neither straighter nor shorter than the other. For example, place an egg on its side upon the table. The line connecting the two ends and passing over the egg is neither straighter nor shorter than a horizontal line connecting the same points.

A hill is objectionable in two ways; viz., it increases the load for the horse and at the same time lessens his ability to draw that load; consequently he must diminish his speed while upon it, thus causing delay. To procure a level route, a road may be economically be increased in length by twenty times the perpendicular height to be saved.

When a weight is drawn up an inclined plane, the weight to be overcome is such a part of the entire weight as the height of the plane is to its length. On applying this principle to a hilly road, we find that if a road rises one foot in every twenty feet of advance, one twentieth of the load must be lifted by the horse through the entire ascent. Hilly roads are also liable to be gullied out by running water. The slope should never be great enough to cause the load to overcome the friction and press upon the horses when descending. This maximum slope is about one foot of fall for every thirty of advance.

We are now ready to consider the bed of the road. In width this should vary from sixteen to thirty feet, depending on the importance and the amount of travel upon the road. Any unnecessary width is to be avoided, as it causes a waste of land as well as an increase in the labor and expense of keeping it in repair.

One of the first requisites of a good road is that its bed should be raised above the general level of the surrounding fields, in order that it may be properly drained. The road-bed itself should be made higher in the middle than at the sides, so that the water may run off as soon after falling as possible. A form of section recommended by high authorities on the subject is that of a semi-ellipse, the major axis being the width of the road-bed. But this form is open to serious objection because of the lack of uniformity of slope from the middle to the sides. This causes all carriages to take the middle of the road, while the bed should be so formed as to induce carriages to travel on all parts equally.

Probably the most advantageous form for a level road is that of two planes meeting at the middle of the road, with a slope of about one in twenty-four each way. When the central ridge has been rounded over this form makes a very uniform bed. Footpaths from four to six feet wide and raised six inches above the road-bed, should be placed on each side of it, and beyond the paths the ditches.

The crying need of the average country road is better drainage. Without good drainage no road can long be kept in good condition, while with it a bad one may be made quite passable. A writer in Paving and Municipal Engineering says that the drainage of the public roads of France – a country noted for its fine highways—is so immediate and perfect that there is not a suggestion of mud or standing water on the roadway, neither during nor directly after a shower.

The ditches should lead to the natural water-courses, and, if open drains, should have a minimum slope of one in one hundred twenty-five. Their size depends upon the situation, but a bottom width of one foot is usually sufficient.

In the specifications for the improvement of the roads about Lenox, Mass., it is provided that underdrains, consisting of unglazed earthenware drain pipe laid in a trench to a true grade, shall be constructed whenever the engineer in charge shall see fit. The pipe after being properly laid, is to be covered with at least eighteen inches of cobble-stone carefully packed, which in turn is to be covered with dry gravel to the general level of the road-bed, thus providing for a very thorough drainage.

The next feature in importance of a good road is its surface. The road-bed surface should be as smooth and hard as possible, and as nearly impervious to water as it can be made. The smoothness is not so much for the comfort of the traveler as it is for economy in the work of drawing the carriage, any equality in the surface forming a miniature hill over which the load must be lifted, besides causing a great loss of momentum by collision. A

loose surface, such as mud or sand, wastes the energy of the moving load by the friction of the wheels against it. On such a road the resistance diminishes as the width of the tire increases, hence it is economy to use broad tires, they also being much less destructive to good roads.

The two principal systems of artificial road covering are the Telford system and that of Macadam, or macadamizing. In the former the road bottom is first dug down a few inches and a foundation is made of unbroken stone, varying in height from six to eight inches. These are set on edge and tightly wedged in place with small stones. Over this foundation is spread from four to eight inches of finely broken stone, none being used which will not pass through a ring two and one-half inches in diameter. The convexity of the road-bed is given to it partially by the form of the earthy bed and partially by making the covering of broken stone, thicker at the center of the road than at its edges. Macadam's system differs from this in that he would use no large stone in the bottom. He makes the covering entirely of stone broken until the largest do not exceed six ounces in weight. There being no foundation but that of the natural soil, this system requires a coating of stone from seven to ten inches in thickness. This is applied in layers of three inches at a time, each layer being left until partially consolidated before another is added. Macadam claims that the whole science of artificial road-making consists in making a solid, dry path on the natural soil, and then keeping it dry by a durable waterproof coating; also, that the weight must be borne by the native soil, not by the covering.

In many parts of our state stone can not be obtained in sufficient quantities for macadamizing the roads. In these sections gravel or dirt roads must be used. These require especially good drainage. In the case of the latter, care should be taken to select the most nearly water proof and most durable soils obtainable for covering. The sods and dirt from the ditches should never be used for "rounding up" the road-bed, as is the custom, for usually these are totally unfit for the purposes, because of their tendency to hold rather than to shed the rain. Good gravel, properly applied and cared for, makes a good covering. All pebbles larger than two and one-half inches should be broken. In applying it a layer of gravel four inches in thickness is first spread over the well-smoothed road-bed, and the road opened to travel, care being taken to fill all ruts as soon as formed. When this has become partially consolidated, the same process is repeated until a central depth of from twelve to sixteen inches has been reached.

Experiments made by the superintending engineer of Central Park, New York City, comparing the Telford and Macadam systems of road-making with good gravel roads, terminated in favor of the latter for park purposes.

That some change in the management of our roads is needed is evident. But before we can have a change for the better, the people must be brought to see the need of having some one whose sole duty it is to care for the roads, and who would stand ready to do any mending *when needed*. Here it is that "a stitch in time saves nine."

EASTERN VIEWS ON WESTERN PAVING.

ENGINEER WOODS, of the Boston street department, who recently visited a number of the cities of America in company with Mr. Cutler, superintendent of the paving division of the Boston department of public works, has prepared a report of their observations. Mr. Wood says:

"Much has been said of late in praise of vitrified brick, but like all new inventions, statements in regard to it seem to be largely exaggerated both as to the amount now in use, and also as to the years of test to which it is alleged to have been subjected. Believing that it was worthy of trial the Boston street department during this last season has had laid three streets in brick of different make as an experiment. These streets have a moderate degree of teaming thereon sufficiently heavy to be good subjects for a test. Seneca street is laid in Keramite brick made in Pennsylvania. Oswego street is laid with brick made in Rhode Island, while Genessee street is laid with the Pennsylvania brick. In addition to results obtained on these three streets, it was thought best to inquire into the experience of some of the western cities, where on account of their location in close proximity to excellent brick yards, the use of such a pavement would more naturally be resorted to for the sake of saving the freight.

"It is found that a brick pavement is smooth, noiseless and easy to clean; that from its shape it can be laid with narrow joints tightly filled with cement, thus making a perfectly tight surface. But it remains to be proven that the surface is not too brittle to chip and not too soft to wear away too rapidly, and not too porous as to absorb too large a percentage of moisture.

"Our experience so far seems to show that there is not only a great difference in the quality of bricks from the different manufactories, but that there is an enormous difference in the bricks made in the same yard, so that until there can be some guarantee that bricks can be vitrified to a desired point, and uniformly so, it is useless to urge a brick pavement for universal use.

"It would seem that if the attention of experts were directed to this matter so as to produce a brick that shall combine toughness, elasticity, homogeneity, resistance to abrasion, heat, water, or frost a brick may yet be produced which shall be welcome as a perfect ideal paving material. It has been stated that this brick has been used in Holland and Belgium for over a century. The truth of the matter is the pavements in both these places have been covered from inches to feet deep with street dirt, consequently the wear has not come on the surface of the brick.

"This kind of paving has been used in Straffordshire, Eng., for upward of fifty years, and in London for paving the approaches to freight depots, where the traffic and vehicles are exceptionally heavy It is used in the same way in Columbus, O., and in Chicago, around the freight depots. Cleveland is said to have forty-five miles, Philadelphia twenty-six miles, largely in outlying districts. So far as could be ascertained, the cities of Wheeling, Johnstown, Allegheny City, Omaha, Indianapolis, York and Baltimore have just begun to lay this form of pavement. Pittsburgh has only two or three streets paved, one a thirty-foot roadway for medium heavy traffic, and after four years it is not considered quite equal to the test. In Allegheny City it was found that with heavy traffic it had

to be removed after six years' service. In Bloomington, where the first pavement was laid fourteen or fifteen years ago, it is claimed that the street is now in good condition.

"The cost of brick pavement varies from $1.50 a square yard to $2.25. The paving of Seneca street cost $2.75 a square yard, and if laid on a concrete base it would cost $3.65. The paving in Oswego street cost $2.40 a square yard.

"Tests made of Ohio brick show that they absorb less than three per cent. of water. About the only form of artificial tests applied are the absorption test either by volume as found from the absormeter or by weight, and the rattler test which consists of a revolving cylinder in which is placed the brick with one hundred or two hundred weight of foundry shot, and the abrasion is ascertained from the loss of weight after a certain number of hours of revolutions.

"Brick paving will no doubt take high rank just as soon as companies shall produce a brick that shall combine all the qualities required to give life to the pavement, uniformity as to vitrification and size, and at a price that shall keep it within the demands for paving streets at a moderate cost.

"A new pavement called the steel wood pavement has come to the surface as a competitor with brick. It is made as follows: 'The soil of the street is graded and thoroughly settled by rolling or ramming, and then covered evenly with two to three inches of fine sand. Steel plates of a thickness and strength to stand a tensile strain of 50,000 pounds to the square inch are laid from curb to curb across the street in three-foot lengths, with flanges or ribs on either side to a height of one and three-eighth inches, suitable holes being provided for pinning the flanges together, the bottoms being perforated for draining. This may properly be called a steel cover to the street.

"For surfacing, a southern pine block 9x4x6 inches is laid by grooving every other block a sufficient height and width to straddle a plate rib, thus closely securing the rib joint and holding the pins immovable. No openings are left between the seams for the accumulation of dirt, swellings being provided for on the sides by leaving a narrow seam next to the curb filled with clay.

"While it is claimed to be the cheapest and the best, and offers great ease of traction, as we are opposed to the use of wood here in Boston for sanitary reasons, we should not be inclined to think favorably of this form of pavement."

GRANITE AND PAVING BRICK IN CAMDEN, N. J.

LEVI E. FARNHAM, city surveyor, and John Blowe, supervisor of streets and highways, of Camden, N. J., in their joint annual report, just out, make the following comments regarding street work in that city:

"Since our last report the use of cobble-stones and asphaltum blocks has been abandoned. We are not insensible to the merits of asphaltum, either in the sheet or block form. It is no doubt smoother, more cleanly and less noisy than stone, and its use on suitable foundations is increasing in our larger cities for boulevards and 'residence' streets. Our city is in an anomalous position, being adjacent to Philadelphia. It is largely a city of homes and many of them of moderate cost. The rapid increase of houses of low cost, with the consequent increase in population, entails in the various departments of education, fire, police, lighting, paving and sewerage, a larger outlay in proportion to the income received from taxes, than other cities which from various causes have a greater number of concentrated values, such as manufactories, warehouses and wharves. For our city, then, it seems the wisest plan to adopt as standard, a paving material having great durability. We therefore prefer No. 1 granite blocks, believing that they possess many characteristics of a first-class pavement, combined with long life.

"As a sanitary precaution they should be laid with pitch and gravel joints. The merit of a granite block pavement (or of any pavement) is greatly increased by using concrete foundations; particularly is this the case in streets of heavy traffic. For those portions of our city where granite block pavements would be too expensive for the abuttors, we recommend a strictly first-class assorted rubble pavement, the stone having at least three straight faces, nearly cubical and laid in rows. This is not an ideal pavement, but when properly laid is fairly smooth, compact and rigid. In common with granite blocks, it has the advantage of being readily removed for making connections with sewers, gas and water pipes. All such trenches being paved without supervision by the various plumbers doing the work, it is self-evident that a durable, detachable form of pavement is required.

"Within the past few years the use of vitrified bricks for street pavements has increased very largely, and when the bricks are made from suitable clays, carefully selected and burned, properly inspected and laid under rigid specifications, we believe they form a durable pavement, not equal in this respect to granite blocks, but far exceeding ordinary asphalt, and possessing the best advantages of an asphaltum pavement in a slightly inferior degree. In view of the increasing use of vitrified bricks as a paving material, the improved article now manufactured, joined with the reduced cost, we recommend that a sample street in the residence portion of the city be laid, either upon a lower course of hard bricks of home manufacture, or upon tarred boards. The cost would probably not exceed $1.60 per square yard and judging from the experience of many cities would be a profitable investment.

"The cost of paving in this city is somewhat less than in other places, considering its distance from the quarries. There is some tendency by the people to cheapen even these low prices, but we believe in municipal improvements, as in other things, the cheapest is not always the best."

THE STREET-CLEANING MOVEMENT IN CHICAGO.

THE people of Chicago have been aroused to an appreciation of the importance of clean streets. A movement has been started by the women of the city, headed by Miss Ada Sweet, to enforce the municipal ordinances against depositing rubbish of any kind on the street, and to have the officers in charge of the streets watched to see that they perform their duties. Through the agency of the organization, the public is also being educated as to the importance of clean streets. The movement is evidently having good effect, as the mayor has just sent a letter to the police magistrates, in which he says: "I wish it now distinctly understood that from this time forth every offender brought before you for the throwing of dirt, papers or filth in the streets must have a fine imposed against him or her, regardless of the social condition or political influence of the defendant. If this is not done I shall be obliged to resort to the severest measures allowed me to compel a proper enforcement of the laws. Offenders of this character who are brought before a police magistrate and are discharged with a reprimand continue to offend and look upon the violations of such an ordinance with contempt. This is one of the most important steps to be taken at this time, for the people must become educated through several months before they will continue to observe the ordinances of the city in this regard. This is not an order to be observed to-day and forgotten to-morrow. This order is to be observed during the rest of this administration strictly."

DRAINAGE AND FOUNDATIONS OF PAVEMENTS.

MR. Harvey Linton, city engineer of Altoona, Pa., in his annual report, just published, says on the subject of paving:

"A pavement must be made so as to prevent surface water and filth from penetrating it, if it is to be a sanitary pavement. The wearing surface of any pavement must, of necessity, be subject to deterioration and more or less frequent renewals. A solid and impermeable foundation is, therefore, a necessity for any durable pavement; it is, in fact, the pavement itself, and the surface may be of whatever material is best suited to the location. It is held by many able engineers that the needs of economy can best be met by requiring, for all pavements, a concrete foundation six inches in thickness. Whenever there is a possibility of water penetrating to the formation upon which the pavement rests, particularly if upon a clay formation, tile drains should be placed below the curb-

stones and connected with the sewer inlets. Curb-stones eight inches in width and nine to fourteen inches in depth (according to the thickness of the wearing surface), similar to those now adopted in Washington, D. C., resting upon an extension of the concrete foundation of the pavement, would be an improvement upon those now used here. They would not be so liable to settlement, and water in the gutters would be effectually cut off from the ground under the foundation."

THE DEMAND FOR PAVING BRICK.

THE supply of paving brick is still inadequate. The entire production for the year of many plants is already sold, and only a comparatively few of the large manufacturers are prepared to fill orders. Letters have recently been received from a number of companies stating that they can meet no further demands. N. B. Abbott, president of the Ohio Paving Company, writes, "We have on hand at the present time about eight million Hallwood block, and have contracts now made sufficient to take them all. Our production will be from eight factories that we are running, about 200,000 per day. We appear to have a place for all we can make." The T. B. Townsend Company have sold their entire output for the season. I. C. Wheeler says that he can not supply more than his local demand this year. The Oskaloosa Paving Brick Company writes, "Our product is sold for the first sixty days of this season to our city to finish last season's contract." Mr. Jas. L. Breed, of the New York Brick and Paving Company, writes, "We are now doubling up our plant, to take off our orders this season. From the present outlook I think that the demand will far exceed the supply. We are shipping our brick to West Virginia and Canada. They are now being used in place of and preferred to an European vitrified brick which was formerly used for the purpose of lining digesters." D. C. Goodrich, of the Franklin Vitrified Brick Company, writes, "We are trying to get started early this season. We are very anxious to get at it, as we know the demand will be great." Many of the companies already in operation have put in machinery for increasing their capacity.

PUBLIC WORK IN SEATTLE.

THE Board of Public Works of Seattle, Wash., has issued a very complete report of the public work of that city, accompanied with maps. A summary shows that the expenditures for the year were: For water-works, $464,116.62; sewers, $65,995, and street grading, $454,668. Little permanent paving has yet been done in Seattle, but the board recommends that the planking now in use there be replaced "as it becomes unfit for use," which is very conservative advice.

IMPROVEMENT OF DULUTH, MINN.

CITY engineer Keating, of Duluth, Minn., reports that the expenditures of his department for 1891, were as follows: Streets, $652,310.07; sanitary sewers, $80,728.06; storm sewers, $119,195.43; sidewalks, $18,496.43—a remarkably good showing for the progressive spirit of the city.

ENGINEERING ASSOCIATION OF THE SOUTH.

AT the March meeting of the Engineering Association of the South, held in Atlanta, Ga., Mr. A. Gude read a paper on the "Granite Quarries of Lithonia, Ga." The paper presented comparative results of the crushing strength of granite from the quarries at Richmond, Va., Stone Mountain, Ga., and Lithonia, Ga., and described fully the quarrying operations at Lithonia. The most interesting point brought out by the paper was the method of "lifting" a quarry or producing an artificial bed covering acres in extent by a single blast hole, a method for producing an artificial bed for the floor of the quarries discovered in the Georgia quarries a few years since. The paper was discussed by Messrs. W. C. Smith, of Nashville, Tenn., J. K. Peebles, of Petersburgh, Va., and T. P. Branch, of Fort Valley, Ga. Mr. Peebles presented a description of the Petersburgh, Va., quarries. Owing to the length of the session and to the unavoidable absence of Mr. James A. Fairleigh, of Chattanooga, his paper on "Municipal Engineering in Chattanooga," was deferred until a later meeting. The paper on the "New Water-Works of Atlanta," by Mr. R. M. Clayton. city engineer of Atlanta, also announced for this meeting, was deferred until a future meeting of the association, on account of Mr. Clayton being suddenly called away from the city.

SAPLESS BLOCK PAVING IN SAGINAW, MICH.

REGARDING the sapless cedar block paving in use in Saginaw, Mich., of which there are 480,385 square yards, City Engineer Roberts, of that city, says:

"All the pavements laid with the sapless blocks are in good condition, without any repairs up to the present time, while blocks laid with the sap on, about the same time and on the same streets, where the conditions are alike, are now quite rounding and rough, while the sapless block wears uniform and smooth. From a close observation of the two kinds of paving blocks, I see no reason why the sapless block will not wear uniform and equal until worn out; and that the common block becomes too rough for a good drive long before the block is worn out is too well known to all who have examined an old cedar block pavement. We laid 33,000 square yards in 1890, 35,000 square yards in 1891, and our Board and Council are so well pleased with them that they have ordered, since Oct. 1, 1891, 40,000 yards of the sapless blocks to be laid in 1892, our experience being that the increase in cost over the common block is fully repaid in the reduced expense in maintenance, to say nothing of the increased life of the pavement and its smooth and uniform surface."

ESSAYS ON ROAD-MAKING.

THE prize essays on the subjects of road-construction and maintenance, published in the *Engineering Record*, have been reprinted in pamphlet form, and constitute a valuable contribution to the literature of road-making. The price of the volume in paper is 50 cents, and in cloth $1.00 per copy.

MILLIONS FOR ROAD IMPROVEMENT.

IT is proposed to create in New York a board of road commissioners, who shall be given the power to borrow $10,000,000 for use in improving the roads of the state. Similar bills will be introduced in several other states.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Measures to Prevent Waste of Water.—When the franchise of a water company provides the maximum charge for a specific service, and also provides that the company may make all needful rules and regulations in connection with supplying water to consumers, and for shutting off of water for non-payment of rate or waste, and where the company adopts a rule to the effect that it may introduce a meter to ascertain the quantity of water being used when waste is suspected, the company may charge its schedule meter rates for all water used in excess of a fair amount for the purpose in question and may shut off the water in case of non-payment.—Geo. and H. B. McDaniel *v.* Springfield Water-Works Co., Supreme Court of Mo., decision Feb. 16, 1892.

Appointment of Non-Resident as City Engineer.—Under Laws N. Y. 1888, c. 214, tit. 2, sec. 2, which provides that no person shall be elected or appointed to any city office unless he is a resident elector of the city, though one is employed to perform the duties of city engineer until he shall become a resident elector, the office remains vacant. Laws N. Y. 1888, c. 214, tit. 3, sec. 2, provides for the appointment of city officers, and declares that if the council shall fail to appoint any such officer within three weeks after any such vacancy occurs it shall be the duty of the mayor, immediately on the expiration of said three weeks, to appoint such officer and fill such vacancy. Where the city engineer resigned, after the expiration of three weeks the power of the council to fill such vacancy ceased.—*Ex Rel.* Caille *v.* Merrick, Sup. Ct. of N. Y., 16 N. Y. Supp. 246.

BOSTON'S SYSTEM OF STREET CLEANING.

BOSTON has spent $215,000 for street cleaning. Engineer Wood says, regarding the work:

"The city has been divided into nine new districts in which the amount of work is equalized, as much as possible, by taking into account the square yards of pavement and the necessity of its frequent sweeping. We have cleaned 7,275.24 miles of streets at an average cost of less than $20 per mile, and we have removed over 77,000 loads of street dirt. The entire force of men employed has been about three hundred. Some streets have been swept every day in sweeping weather, some three times a week, and some twice a week. Each day's work has been so assigned that the computed area covered per week has been figured up to about 590,000 square yards to a district.

"For a paved district a good working gang is composed of one foreman, one sub-foreman, two sweeping machine drivers, two water cart drivers, sixteen sweepers, six teamsters, six helpers, one dump inspector. Such a force costs about $23,000 for a full year.

"Eighty-one per cent. of all our streets are either gravel or macadam, and the cost of cleaning averages about $65 per mile for each cleaning.

"The introduction of the push-cart patrol system, as an important adjunct to the regular street-sweeping force has found approval in the tidy appearance of our business thoroughfares. It is astonishing to note the rapid collection of newspapers, paper bags, sticks, fruit skins, odds and ends of all kinds in addition to the regular street dirt, that is constantly being scattered upon the surface of the streets, filled with teams and people. It is found that, even after a street has been once thoroughly swept, in less than two hours time the sweeping off of the sidewalks and the throwing away of waste material into the street will so disfigure its surface that it appears as though the street cleaning force had neglected it in its daily rounds. To obviate this difficulty the push-cart patrol comes in, collecting and removing this refuse matter continually throughout the day. A patrol cart makes periodical trips through the district, and empties these push barrels as fast as they are filled. The first cost of each cart is $27. The odorless dumping cart has been found useful for very wet material. They are made of iron and are thoroughly durable. Their capacity is fifty cubic feet."

THE SEWERAGE OF AMERICAN CITIES.

To the Editor of Paving and Municipal Engineering:

SIR—While all city improvements are deemed necessary our cities will naturally depend in the future on our engineering journals of the country for a thorough understanding of the importance of perfected sewer systems.

Why has this, the most important of all questions in any city been so sadly and persistently overlooked? No city can be supposed to be forever exempt from plagues and pestilences, and as the city grows older the danger increases. My humble opinion is the sewers should be constructed along and under the alleyways to ensure them being tapped at a nominal cost and to provide a quick and continuous drainage of the back ends of lots where such drainage is mostly needed. The rear ends of all old city lots by the absence of sewers are contaminated deeply below the surface and in case of existing pestilence it would require a period of one generation to properly fumigate them. We are not sure that this continuously filthy surface of thickly populated cities extending over a period of a thousand years or more has not been the primary cause of all of those old incurable diseases having their origin in old Asia and Europe. My experience has proved that the soil of old lots having no drainage in the rear ends are stained by this poison to the depth of ten feet. If the sewers were under the alleys a few feet of pipe would tap them at less expense than cleaning the vaults. Such sewers and tappings should be made compulsory. If all houses should have connected ordinary automatic flush tanks attached to the premises by pipes the rain-water alone would be a cheap and effective aid to this very necessary cleanliness.

Finally, I do not mean to be presumptuous by suggesting that all members of a city council should keep and have for ready reference a good civil engineers' or municipal engineering journal to aid them in their duties to the public.

It is no criticism on an intelligent, successful business man to say that he needs such an aid any more than it is to say that he should keep a dictionary in his family. He should be able to understand something of the duties of his engineer and other officers and contractors from his own personal knowledge. Much bad and therefore costly work is done by contractors who do not and will not do fair work. Good contractors frequently fail to get the work to do. D. E. CONNER, C. E.

Covington, Ky., March 24th, 1892.

A LOCATION FOR A PAVING BRICK PLANT.

To the Editor of Paving and Municipal Engineering:

SIR—The shale shown at your great exposition from Higginsville, Mo., from which the best of vitrified or metalized brick were made that were shown there, is inexhaustible. Higginsville wants paving brick and Sedalia, Mo., would take millions and Kansas City millions more. The only thing in the way of building up a wonderful and paying business is that there is nobody living in this city or near it that knows anything about making paving brick. Some man who has some capital and knows the business could coin a fortune in a few years. STANLEY B. WALKER.

Higginsville, Mo., March 29, 1892.

TWO CORRECTIONS.

To the Editor of Paving and Municipal Engineering:

SIR—In my last article in your journal, a part of what I said, or intended to say, was omitted. In quoting Mr. Greene and his definition of asphalt, I thought that my copy contained the following: "Asphalt is a variety of bitumen found in a native condition, and not manufactured, and in a solid form is commercially known as *glance* pitch." I was quite certain that this was in the copy but I am old enough to know that there is no greater chance of being mistaken when one is sure he is right. I ask you to make the correction in the next number of the paper. Respectfully,

Indianapolis, Ind., March 16, 1892. LOUIS H. GIBSON.

To the Editor of Paving and Municipal Engineering:

SIR—Please mention in your next edition the following erratum in my March communication: "Many chemists and geologists suppose it to be of a vegetable or *mineral* origin," which ought to be of vegetable or *animal* origin. Yours truly,

New York, March 18, 1892. E. J. DE SMEDT.

"A CLEAR CASE."

A BROCHURE, original in style, has been issued by Messrs. E. M. Freese & Co., of Galion, Ohio. It is entitled "A Clear Case." The case is "Brick Machinery, Latest and Best, plaintiff, v. Brick Machinery, Behind the Times, defendant," and the contents comprise the testimony of witnesses called on behalf of the plaintiff, given in the form of fac-simile letters of the strongest character from eighteen of the leading paving-brick manufacturing firms of the country.

A NEW catalogue has been issued by the American Road Machine Company, giving a vast amount of information regarding road machinery, together with useful hints regarding road making.

MR. C. W. RAYMOND of Dayton, Ohio, has published in attractive form fifteen testimonial letters from leading paving brick manufacturers as to the exceptional merits of his automatic paver re-press, "The Columbian."

MINERALS is the name of a new monthly magazine treating both popularly and scientifically the various subjects embraced in minerology. It is published by the Goldthwaites, No. 132 Nassau street, New York. Subscription price, $1 per year. It makes an auspicious beginning.

ROBERT CLARKE & CO., of Cincinnati, have published a pamphlet of eighty-five pages entitled "Brick for Street Pavements," written by M. D. Burke, C. E. It gives an account of tests made of fifteen varieties of bricks and paving blocks, with a brief discussion of pavements in general and methods of constructing them. The price is $1.00 per copy.

Improvement and Contracting News.

PAVING.

Decatur, Ill., has twenty-six miles of paved streets.

Genoa, Ohio, will spend $5,000 in street improvements.

Kearney, Neb., is agitating paving for Central avenue.

Middlepoint, Ohio, will improve surrounding roads.

Zanesville, Ohio, has sold $50,000 of street and sewer bonds.

It is proposed to pave all the new streets at Alexandria, Va.

The Public Square at Piqua, Ohio, is to be paved with brick.

About 250 cities in the United States are now paved with brick.

About $300,000 will be spent for paving this year at Omaha, Neb.

Redlands, Cal., will spend $100,000 in street improvements this year.

Canton, Ohio, has a new paving brick company with a capital of $30,000.

Broadway, Baltimore, Md., will be repaved with sheet Trinidad asphalt.

Minneapolis, Minn., will spend about $68,000 this year on her park system.

Three thousand square yards of granite paving blocks are to be laid in Holyoke, Mass.

Savannah, Ga., has expended within the last five years, nearly $400,000 in street paving.

Delaware avenue at Wilmington, Del., is to be widened ten feet at an estimated cost of $75,000.

The paving of Elm street at Westfield, Mass., with granite blocks is estimated to cost $30,000.

Contracts have been awarded at Toledo, Ohio, for $19,370.75 worth of street paving and grading.

The people of Ridgewood, N. J., voted to bond the township, for $30,000 to macadamize the roads.

Leipsic, Ohio, is agitating the question of paving the main street in that town with fire-clay brick.

Messrs. Stainthrope will pave the tracks of the street railway at Niagara Falls at a tender of $40,000.

The residents of Sherman avenue, Mansfield, Ohio, want that thoroughfare graded and paved with brick.

The State Legislature of Illinois is to be petitioned to appropriate $10,000,000 for highway improvements.

The tax-payers of Abington township, Pa., will vote on the issue of $240,000 of road improvement bonds.

Hayes & Quill will pave Daniels street, Cincinnati, Ohio, Euclid to Jefferson avenues, at a bid of $7,705.50.

It will take almost 2,000,000 cedar paving blocks to fill all the contracts in the city of Bay City, Mich., this year.

The Vulcanite Paving Company was awarded contracts for paving in eight streets in Philadelphia, Pa.

Fifty thousand dollars of paving bonds will be sold by the city treasurer of Omaha, Neb., on the 25th of April.

The finance committee of Boston, Mass., has been requested to provide $85,000 for the improvement of Seaver street.

George W. Lemon, of Wheeling, W. Va., has been awarded the contract for paving South Erie street at Massillon, Ohio.

Folz & Jones were awarded contracts for paving four streets at Cincinnati, Ohio, with granite blocks at a cost of $95,924.

City Engineer Thorpe, of Bozeman, Mont., is engaged in making surveys of different streets preparatory to grading.

Three paving districts have been created at Ogden, Utah, and the city council has voted to issue paving bonds for $150,000.

The town board of Hempstead, L. I., has been petitioned to macadamize five miles of the Moriches and Jamaica plank road.

The Board of Public Works of Detroit, Mich., has prepared a list of streets to be paved, the estimates aggregating $200,000.

It has been voted to repave Atlantic avenue with granite block at a cost of $235,000 at Brooklin, N. Y., by the Board of Aldermen.

Four and a half per cent. bonds for $40,000 to build ten miles of Telford road in Moorestown township, N. J., have been voted.

It will require a million brick to lay the pavement on South Main street, at Findlay, Ohio. Funk & Coleman are the contractors.

It has been voted by the street committee of San Francisco, Cal., to pave thirteen streets with bituminous rock and one with basalt blocks.

Broad-tired wheels are essential not only in retaining good streets after once constructed, but are, in themselves, good street-makers.

The yearly appropriation of $450,000 for cleaning Chicago's 700 miles of paved streets and 1,600 miles of unpaved streets, is insufficient.

The senate has passed a law authorizing the commissioners of Franklin county, Ohio, to issue $20,000 in bonds for road improvements.

The council of Ashtabula, Ohio, adopted a resolution for the paving of Center street. This will be the first street in the city to be so improved.

A new pavement will be laid on East Wayne street at Ft. Wayne, Ind., for a width of 32 feet from Hanna street to Hanover street.

A considerable amount of Brick paving and macadamizing is expected to be done this year at Dunkirk, N. Y. F. A. Dunham is city engineer.

The Southern Construction Company received the contract for paving West Ninth street and East Terrace, at Chattanooga, Tenn., for $14,745.05.

Sealed proposals will be received at the office of the board of Hamilton County Commissioners at Cincinnati, Ohio, until Wednesday April 20th for the improvement of Pleasant Ridge & Madisonville road, Columbia township.

Contracts have been let for paving Grand avenue at Everett, Wash., with California bituminous rock. The other streets in that vicinity will be planked.

There is a movement on foot for the paving of Wilkins street, from Russell to Rivard streets, with cedar blocks on plank foundation, at Detroit, Mich.

The Tennessee Brick Company has been awarded a contract for 56,000 square yards of brick pavement on nine inches of concrete, to be laid at Lexington, Ky.

A new paving company has been incorporated at Philadelphia, Pa., with a capital stock of $100,000. John M., James M. and Joseph P. Mack are the incorporators.

Plans are being made for important public improvements at Fond Du Lac, Wis. The sewer system will be extended, and a number of streets will be paved.

Clinton, Ia., recently asked for bids for 60,000 square yards of brick paving, and Dubuque, Ia., also asked for tenders for 28,000 square yards of the same material.

The city engineer of Lansing, Mich., has been instructed to prepare plans and estimates for the work of grading Prospect and Eureka streets from Hosmer to Jones streets.

A. McCurdie submitted a bid of $11,174.19 for paving Banks avenue between Third street and the Omaha railroad right of way at Superior, Wis., and was awarded the contract.

A resolution has been recommended to improve Oak street from Parsons avenue to Eighteenth street, Columbus, Ohio, by surfacing with asphalt at an estimated cost of $11,411.50.

J. B. Smith & Co., of Chicago, were awarded the contract for 9,300 square yards of vitrified brick paving by the council of Kenosha, Wis. Their bid was for $1.66 per square yard.

The Barber Asphalt Paving Company has been awarded the contract for paving Walnut street from Thirteenth to Sixteenth streets with asphalt on concrete at $2.25 a square yard.

The Warren Scharf Asphalt Company will pave Crescent avenue from Canal to Division street, and South Lafayette street from East Fulton to Cherry streets, at Grand Rapids, Mich.

Van Wert county, Ohio, is about to make a practical solution of the county roads question. Citizens of one township voted four to one in favor of the proposition to expend $100,000 for piking roads.

The mayor and city engineer of Denver, Colorado, are working at the final arrangements for macadamizing a number of streets in the residence portion of the city. The property owners will pay the cost.

The commissioner of public works of New York City has submitted a list of streets to be paved with the special appropriation of $1,500,000. It includes granite blocks on concrete, and asphalt on present stone.

The Rockport Granite Company received the contract to furnish 300,000 large granite paving blocks to the street department at Boston, Mass., and James F. McIntosh received the contract to furnish beach sand.

The California Sewer Pipe Company, of Los Angeles, Cal., is engaged in laying 800,000 bricks on E street at San Bernardino. It is the first paving of the kind in the city and is attracting much attention. San Bernardino intends to have some of the finest streets in the State.

The city surveyor of Montreal, Canada, is having a report prepared showing the total amount of permanent pavements in existence. The report will give the maker's name, the material used, the date of laying it down, etc. The idea is to compare the permanency of the various grades of pavement.

Contracts for paving with asphalt Ellicott street, from Northampton to Riley streets; Genessee street, from Main to Niagara Square and Morgan street, from Chippewa to Mohawk streets at Buffalo, N. Y., were awarded to the Barber Asphalt Co. at bids of $6,329.00, $17,024.00, and $12,300.00, respectively.

Last year, Covington, Ky., laid about 1,598 lineal yards of macadam on its streets and about the same length of new streets were graded, and it also laid 14,147 perches of macadam in repairs alone, at a cost of $1.29 per perch, with an additional cost of eighteen cents per perch for spreading. In the same year the Warren-Scharf Asphalt Company began a $300,000 contract for laying asphalt on some of the principal avenues and will finish the same this spring. Covington does not show a spirit to succumb to deterioration by standing still, but is keeping abreast of the times.

SEWERS.

Sewers are to be built in three streets in Troy, N. Y.

Clinton, Mass., has voted $15,000 for additional sewers.

Sewer building at Aurora, Ill., is expected to begin soon.

Tiffin, Ohio, has spent $97,000 in sewers within the past ten years.

Camden, N. J., has thirty-five miles of sewers, which cost $395,000

A system of sewers will be built this spring at Red Jacket, Mich.

C. Cronan was awarded a $13,385 sewer contract at Cincinnati, Ohio.

A twelve-inch sewer is being laid in Mitchell street, Portland, Ore.

Springfield, Ohio, will construct $27,000 worth of sewers this summer.

James Markey will build $11,766 worth of sewers at Kenosha, Wisconsin.

Denver, Colorado, has voted $30,000 to complete the proposed storm sewers.

About forty miles of lateral sewers will be built at Muskegon, Mich., this year.

The council of Georgetown, Col., has prepared specifications for 4,000 feet of sewers.

Hancock, Mich., will be bonded in the sum of $35,000 to put in a sewerage system.

Maps and plans for a complete system of sewers have been prepared for Oneida, N. Y.

Plans are being constructed for a complete system of sewerage for Olympia, Wash.

Tonawanda, N. Y., has voted to issue bonds for $20,000 to complete its sewer system.

Nantucket, Mass., has voted on the question of an appropriation of $36,000 for sewerage.

The town of East Providence, R. I., is asked for $18,000 for a proposed sewer extension.

Contracts for constructing sewers in four streets at Grand Rapids, Mich., have been awarded.

It will take about 460,000 bricks for Wolf & King's sewer contract at South Superior, Wis.

Plans have been made for the construction of sewers in sewer district No. 1, at Fostoria, Ohio.

Clifton Bros. received the contract for sewers on the main streets of Owatonna, Minn., for $8,500.

The city council of Provo, Utah, has taken steps looking to the construction of a sewerage system.

The legislature has authorized the city of Northampton, Mass., to issue bonds for $100,000 for sewers.

Thirty thousand dollars is the annual appropriation for sewers and drains in Manchester, N. H.

New sewers in three streets have been recommended by the committee on sewers at Lawrence, Mass.

Preparations are being made to construct a more complete system of sewers for Brockton, Mass.

A sewer extension to cost $14,000 was favorably reported by the street committee of Birmingham, Ala.

A sewer will be laid on East Twenty-first street near Eighth avenue, by J. S. Carr, at Oakland, Cal.

It is intended to spend $112,000 on sewerage at New Whatcom, Wash. Ten miles of pipe are to be laid.

A sewer contract has been awarded to Frederick Fisher at Terre Haute, Ind., in consideration of $14,540.

The citizens of Fremont, Neb., will vote to bond the city for $100,000, for a complete system of sewerage.

Thomas F. Moore was the lowest bidder for the Ontario street sewer at Buffalo, N. Y. His bid was for $17,900.

Forty-five thousand dollars has been appropriated for the construction of the West Nashville (Tenn.) sewer.

F. K. Baxter, ex-city surveyor, has prepared plans and specifications for a new sewer system for Herkimer, N. Y.

Keefe & McGarvey were awarded a big contract for sewerage and water-works at Ft. Collins, Neb., amounting to $56,000.

It seems that Columbus, Ohio, is to have a sewage farm, and, if so, the pollution of the river will soon be a thing of the past.

The residents of Elizabeth street have petitioned for a sewer to connect the Spruce avenue sewer at Sault Ste. Marie, Mich.

It is proposed to construct a sewer in Bailey avenue, Buffalo, N. Y., to cost $128,000 and the length is about two and a half miles.

Walter F. Randall, of Syracuse, is preparing plans and specifications for a system of sewerage for Norwich, N. Y. It is thought that about 18 miles of pipe will be required, and the total cost be less than $100,000.

The sewer system at Boise City, Idaho, is completed. It cost nearly $50,000, and is of sufficient capacity for a city of 25,000 population.

A proposition has been made to the Mayor of Denver, Col., by the Western Sewage Company for the disposal of the city sewage.

Mr. Dawson, city engineer of Peru, Ill., has prepared plans and specifications for the sewer system in the northeastern portion of the city.

The board of public works has declared it necessary to construct a main trunk sewer in two streets at Columbus, Ohio, at a cost of $30,059.

The common council finance committee has approved an ordinance appropriating $1,500 for the Fifteenth street sewer at Harrisburgh, Pa.

The contract for building Section 3 of the outfall sewer at Moon Island, Boston, Mass., has been awarded to Perkins & White, at $71,904.

Mr. Allan MacDougall, of Toronto, has submitted plans for a system of sewers for the town of Peterboro, Ont. The cost is estimated at $150,000.

The estimated cost of the proposed system of sewers to be built at Wilkinsburg, Pa., and to empty into the Monongahela river, two and one half miles distant, is $140,000.

At a town meeting of citizens and councilmen at Reading, Pa., it was decided to recommend an appropriation of $200,000 for a storm and house-drainage system of sewerage.

M. C. Reichert received the contract for the north side sewers to be constructed at Racine, Wis. The amount is $25,037. This makes about $60,000 worth of sewers contracted for at Racine this year.

Bids for constructing the sewerage system in Jackson Park, Chicago, Ill., were opened and it was found that twelve miles of mains would be required for the service. Thomas Byrne was awarded the contract.

J. W. Pearl was awarded the contract for sewers at Benton Harbor, Mich., in consideration of $17,500. It includes 3,435 feet of 36 to 48-inch double ring brick, and 2,556 feet of 12 to 20-inch vitrified pipe sewers.

The contract for performing the work and furnishing materials for the construction of a sewer at Nantasket, Mass., has been awarded to Connolly Bros. The work must be completed by May 31 of this year, and will cost $15,000.

During the year 1891, Covington, Ky., constructed 3735 lineal yards of vitrified stoneware pipe sewers, ranging in size from 15 to 24-in., the 18-in. largely predominating, and also 426 feet of brick sewer 3 feet in diameter. The city now has in contemplation the construction of a trunk sewer 1,000 lin. yds. in length, 14 to 16 ft. in diameter, to cost $185,000.

New Orleans, La., is the only civilized city in the world wholly without sewers. A franchise has recently been granted to a private company to build sewers, and the company expects to have the entire city sewered within the next three years. New Orleans is generally below the level of the Mississippi river, therefore, the sewage will have to be artificially elevated and directed into the river.

WATER-WORKS.

Oxford, Ala., is to have water-works.

Bedford, Ind., is to have new water-works.

Brookfield, Mo., is putting in water-works.

Northville, Mich., is to have new water-works.

Steps are being taken to secure water-works for Barre, Mass.

Evansville, Wis., will vote on issuing bonds for water-works.

The borough of Rutledge, Pa., has voted in favor of water-works.

It is reported that water-works are projected for Harrison, Ark.

It is said that water-works are soon to be built at Arkville, N. Y.

The system of water-works at Rockdale, Kan., will soon be completed.

The contract for a water-works system at Springtown, Tex., has been let.

Authority to build new water-works at Cumberland, Md., is being sought.

New water-works has been commenced at Ft. Worth, Tex., to cost $600,000.

It is reported that water-works will be built this summer at Chehalis, Wash.

Surveys are being made for water-works soon to be built at Woodstown, N. J.

W. W. Taylor has been investigating the proposed water supply for Hanover, Pa.

The sum of $20,000 has been appropriated for mains and hydrants at Brocton, Mass.

Brooks & Jewell are building water-works at Mount Upton, N. Y., to supply spring water.

The contract for a first-class system of water-works to be built at Mt. Sterling, Ky., is closed.

A direct pumping system will be introduced into the water-works system at Lemoore, Cal.

The water-works company of Iron Mountain, Mich., will spend $50,000 in improvements this year.

Eldon, Iowa, voted on the water-works question and decided by a large majority to put in a plant.

A water-works contract has been let for a $16 000 system to be constructed at Greeley Centre, Neb.

B. J. C. Howe, of Indianapolis, was given the contract for building a water-works plant at Stanford, Ky.

The council of Carrollton, Ga., has ordered an election to be held on April 18, to vote on water-works.

A bill has passed the lower house to allow Willoughby, Ohio, to issue $50,000 bonds to build water-works.

East Lake, Ala., is to have a system of water-works. The water to be furnished is to be pure spring water.

The much-needed water-works is assured for LaGrange, Ore., and $20,000 is now available for the works.

The water-works system at Bellevue, Ohio, will be improved and $15,000 bonds will be issued for that purpose.

The people of Monroe, La., will, on May 21, vote on levying a 5-mill tax for water-works, electric lights and sewerage.

Dennis Long & Co., of Louisville, Ky., were awarded the contract by the Board of Water Commissioners for cast iron pipe and specials for the water-works at St. Paul, Minn., the prices being $23.95 per ton for pipe and $50 per ton for specials.

Plans have been nearly completed for a 50,000 gallon reservoir in connection with the new water-works at Austin, Tex.

The time for receiving bids for pipe, specials and hydrants for Austin, Tex., has been extended from April 18 to June 22, 1892.

The council of Halifax, Nova Scotia, has decided to construct an additional line of water pipes into the city at a cost of some $30,000.

Gray & Temple will construct water-works at Mechanicsville, N. Y., for about $39,000. The work will be completed by November.

H. H. Harrison, of St. Paul, received the contract for a system of water-works to be built at Redwood Falls, Minn. The plant will cost $2,925.

Tecumseh, Mich., voted on the question of bonding the village for $35,000 to build water-works, and the vote was carried by a large majority.

The water-works system at Franklin, Pa., was constructed at a cost of $84,760.43, and $85,000 was appropriated, so a small balance remains.

The Appleton (Wis.) water-works company has been re-organized with a capital of $200,000, and amended articles of incorporation have been filed.

Five miles of new mains will be added to the water-works of Abilene, Tex., and this will give that city the best equipped water-works in the state.

Mr. Stephen E. Babcock, civil and hydraulic engineer, has devised a plan for a water supply for Ticonderoga, N. Y. The estimated cost of the system is $61,019.20.

A private corporation was awarded the contract to build water-works at Portland, Ind., consisting of 11 miles of mains and 150 fire plugs, for which the city will pay an annual rental of $3,260.

Water-works will be built at Yoakum, Tex. and are to be put into operation by June 3d, to consist of 12,000 feet of mains and 900 feet of smaller pipe, 50 fire hydrants and a 12x100 stand-pipe, and a guaranteed capacity of 150,000 gallons daily.

BRIDGES.

A bridge is to be built across the river at Bracebridge, Ont., at a cost of $2,000.

Two bridges are being constructed over the Muskingon river at Forest, Ohio.

A bridge will be built across the Kaw at Endora, Kan., this year.

A new highway bridge is to be built across the Missouri river at St. Charles, Mo.

Work has commenced on the bridge to span East Bijou Creek at Byers, Colo.

Seneca county, Ohio, will issue $15,000 bonds to build a bridge over the Sandusky river.

A contract was let for a $10 500 bridge to be built at the foot of Pacific avenue at Seattle, Wash.

Two bridges across the North and South Gabriel, near Georgetown, Tex., will soon be completed.

The Wisconsin Bridge Company is building the iron bridge across the Llano river at Llano, Texas.

A timber highway bridge 500 feet long will be built over Cape Neddick river at York Beach, Me.

Plans, prepared by W. Hildebrand, of New York City, for the proposed Quincy street bridge at Topeka, Kan., have been accepted by the county commissioners.

The senate passed a bill authorizing the construction of a bridge across the Osage river at Warsaw, Mo.

The new bridge over Black river, near La Crosse, Wis., has been completed and thrown open for use.

Middlesex county, N. J., will issue $100,000 of bonds to provide for building new bridges in the county.

At K street, Washington, D. C., a steel plate girder highway bridge will be built over James Creek canal.

It is said that the commissioners have decided to build a new iron bridge across the Killbuck, at Millersburg, Ohio.

A bridge will be built across the Lehigh river at Lower Catasauqua, Pa. The contract was awarded at a bid of $11,595.

T. B. Townsend & Co. will build a stone arch bridge at the foot of Main street, Mt. Vernon, Ohio, at a cost of $30,554.12.

The Columbian Bridge Company has been chartered in Illinois to build a bridge across the Illinois river at Columbia, Ill.

A $10,500 iron bridge will span the Snohomish river at Everett, Washington. The Washington Bridge Company will build it.

The authorities at Vicksburg, Miss., have awarded the contract for a $15,000 swing bridge to the Columbus Bridge Company.

The City Council's committee of Baltimore, Md., has decided to build a stone bridge over Jones' Falls at a cost of $381,000.

The corporation of the city of Toronto, Ont., has filed plans of the proposed swing bridge in that city across the river Don.

Two new bridges are to be built across the Ohio river at Wheeling, W. Va. One to Bellaire and the other to Kirkwood, Ohio.

G. E. Ingersoll of Great Falls, Mont., was awarded the contracts for two bridges to span Deep Creek, in consideration of $9,550.

A $25,000 iron bridge will probably be constructed across the Colorado river at a point between Eagle Lake and Vox Populi, Texas.

The toll bridge across South Fork at Haller, Wash., has been purchased and will be open to the use of pedestrians without charge.

The common council of Saginaw, Mich., voted to issue bonds to the amount of $200,000, for the proposed new bridge work at that place.

The Hennepin Bridge Company has been authorized to build a bridge across the Illinois river at Hennepin, Ill., at a cost of about $25,000.

The plans of the Missouri Valley Bridge Co. to build a wagon bridge from Galveston Island to the main land have been accepted. Cost to be $175,000.

The plans of the new Burlington bridge over the Mississippi at Alton, Ill., make it a double track structure with eleven spans. There will be a 400 foot draw.

The new bridge over Fall creek, Indianapolis, Ind., is completed, and the electric cars are running to North Indianapolis without transfer at the bridge.

The state legislature of Virginia has passed a bill authorizing Warren county to borrow $12,000 for the construction of a bridge over the Shenandoah river.

The commissioners of Park county have passed the order for the county to build a free wagon bridge across the Wabash river at Montezuma, Ind. It will cost $30,000.

Doe, Hunt & Co., of San Francisco, have been let the contract for building the bridge over the Guala river for $13,469. The bridge will be a combination truss with a 320 foot span.

The city council of Buffalo, N. Y., has appropriated the sum of $37,500 for the bridge at Elmwood avenue, which is to be built by the park commissioners. The appropriation for the structure is now $75,000, and the cost of same will come within that limit.

A bridge is being constructed across the Thames river, near the Tower of London, and is to be known as the tower bridge. It will cost $3,500,000, and 31,000,000 bricks, 70,500 cubic yards of concrete, 19,500 tons of cement, 235,000 cubic feet of granite and other stone, and 15,000 tons of iron and steel are to be used in its construction.

The contract for building the Twenty-third street bridge at Bay City, Mich., was awarded the Milwaukee Bridge Co. The plans and specifications provide for a steel bridge 495 feet long, consisting of two fixed and one shore span and a draw 210 feet in length. The total cost of the bridge will be $23,647.

STREET LIGHTING.

Homer, Mich., has voted in favor of electric lights

An electric light plant is to be established at Dresden, Ohio.

A new electric light company is being organized at Waltham, Mass.

Wellston, Ohio, will spend $18,150 in erecting a municipal electric plant.

Buffalo, N. Y., has contracted for electric lights for five years at 35 cents per light per night.

A new company is being organized to furnish the city of Columbus, Ind., with electric lights.

An electric light franchise has been granted to W. G. Curtis and F. B. Hoskins to light Fon du Lac, Wis.

The mayor of Jefferson City, Mo., called a special election to vote on the question of electric lighting for that place.

The citizens of Bellefontaine, Ohio, will vote on the issuance of $30,000 bonds for the erection of an electric light plant.

The village trustees of Holley, N. Y., are authorized to make a contract for street lighting for three years, as soon as the present contract expires.

The Thomson-Huston Company has received a contract to furnish 50 arc and 1,000 incandescent lights to the city of St. Peter, Minn., for $13,700.

The Dundee Electric Light Company has been granted a franchise, and will furnish sixteen arc lights, at $60 each year, to the city of Dundee, Mich.

Philipsburg, Mont., has contracted with the Philipsburg Granite Electric Light Company for eleven arc lights of 2,000 candle power, at $15 each per month.

The Albina Light and Water Company, at Albina, Wash., will put in a 500 horsepower engine in the spring, which will operate all the dynamos in the plant.

The city's electric light plant will have to be enlarged at Crawfordsville, Ill., improvements to consist of new dynamo, new engine, and about 300 incandescent lights.

The electric light plant at Bowling Green, Ohio, has been sold by the common council to E. H. McHight, who will make improvements and operate it in the future.

The Edison Sault Electric Company has been incorporated with a capital stock of $57,000 for the purpose of furnishing electric lights to the town of Sault Ste. Marie, Mich.

The Brush Electric Light Company has accepted the terms of the city of Cleveland, O., for street lighting. They will receive $95 a year for each light of 2,000-candle power.

A special election was held at Estherville, Ia., and the question of granting a twenty years franchise to an electric light company to put in a plant at that place was carried.

Engineer W. A. Burkholder, of Portland, will superintend the construction of the electric light system of the Washington Electric Company, at Seattle, Wash. The plant will be put in for 1,000 incandescent lights.

An electric light company has been incorporated at Point Pleasant, W. Va., with capital stock of $8,000. It is known as the Point Pleasant Electric Light and Power Company, with D. S. Snyder and F. M. Durbin, incorporators.

The Indianapolis Brush Electric Light Company has purchased the Scott-Nicholson stone yard on Kentucky avenue, between Louisiana and West street, for the consideration of $16,000. It is the intention to build a plant upon the site.

Sealed proposals will be received by the city clerk of the city of East Liverpool, O., until February 29th for the lighting of streets and public grounds of said city by electricity of fifty arc lights. Bids will be received for lighting said city for a period of three years from March 1st, for five years from March 1st, for seven years from March 1st, and for ten years from March 1st. W. H. Griggs, city clerk.

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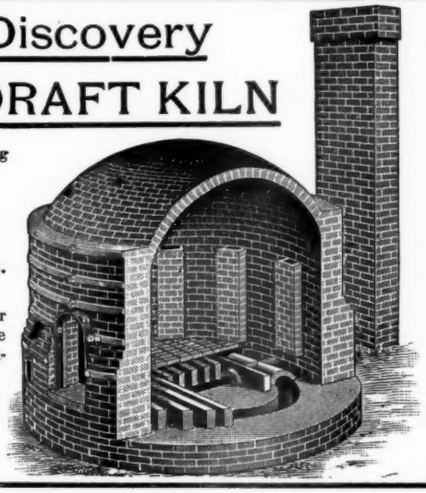

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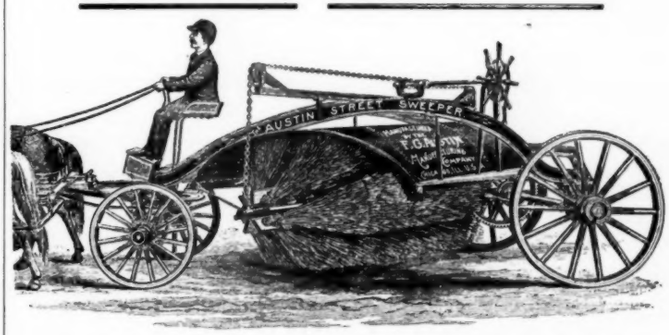

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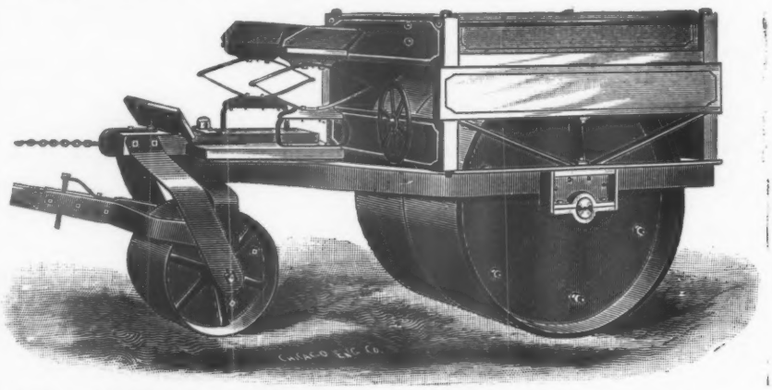

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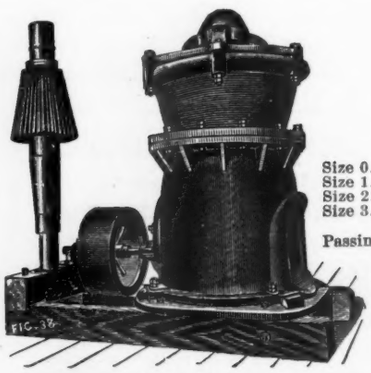

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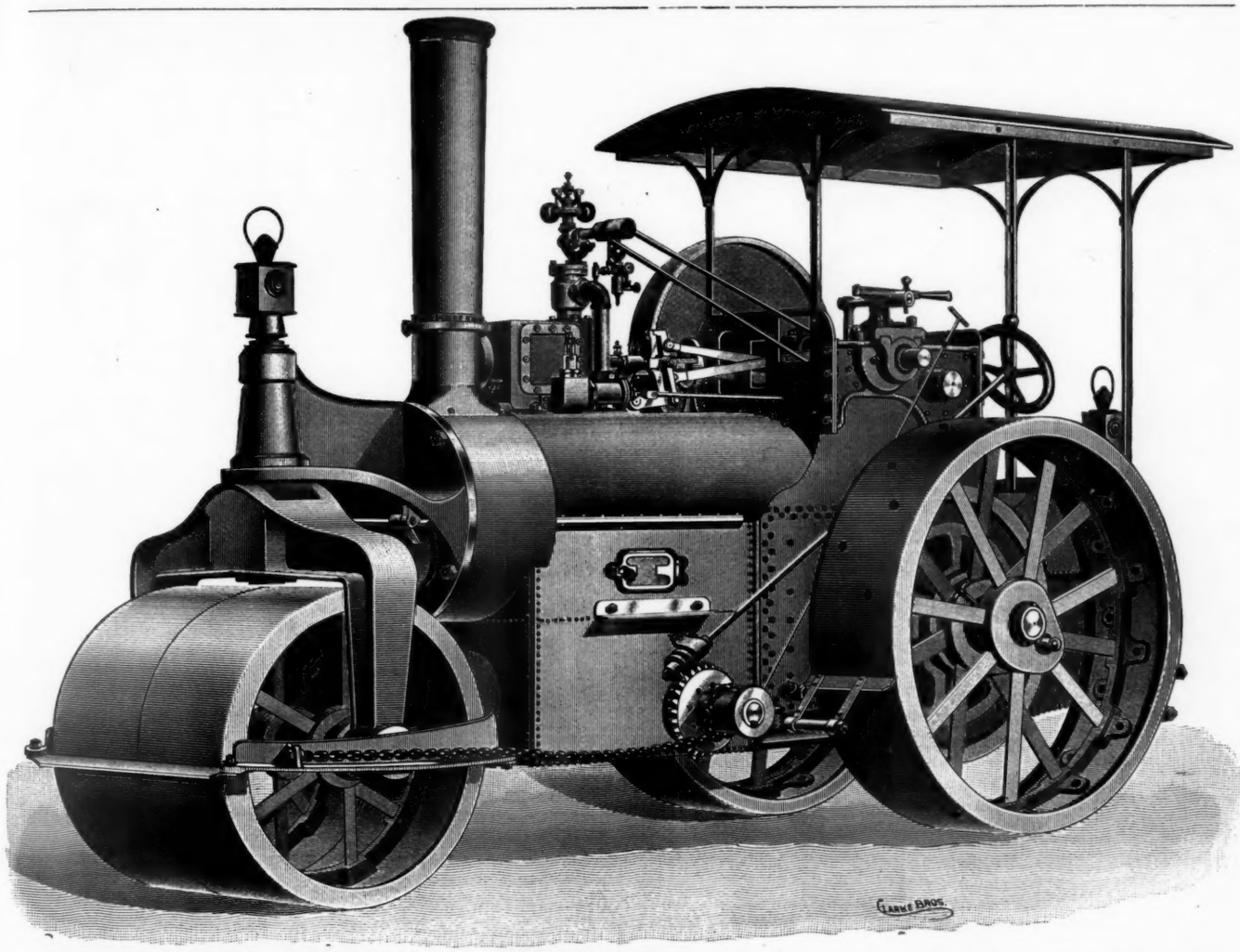

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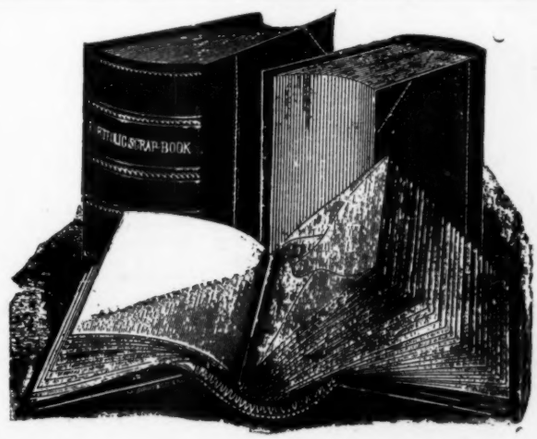

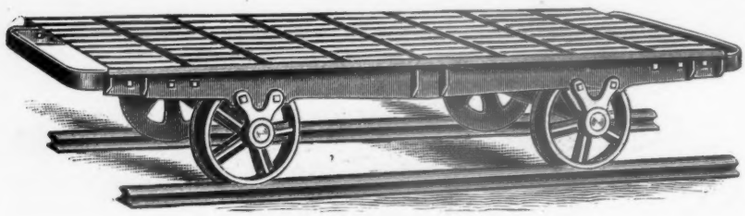

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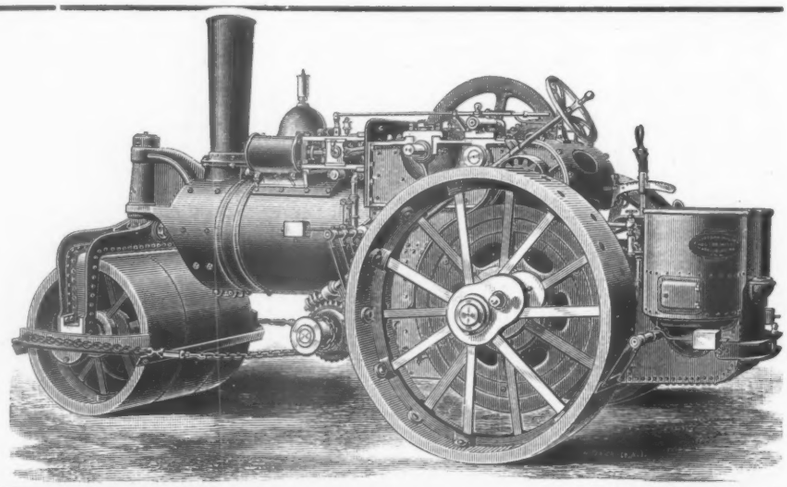

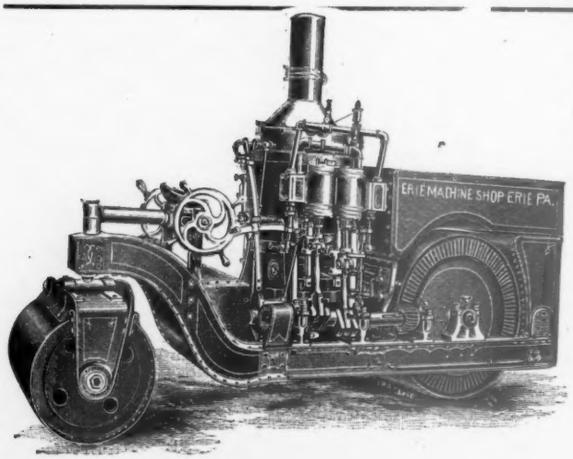

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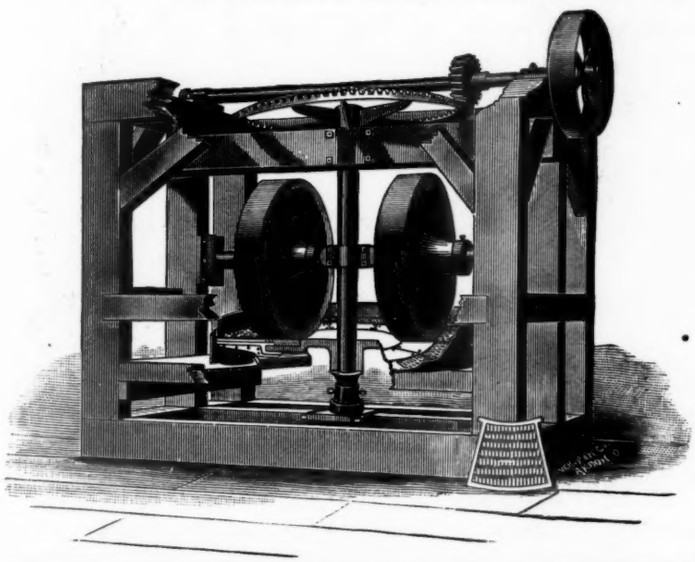

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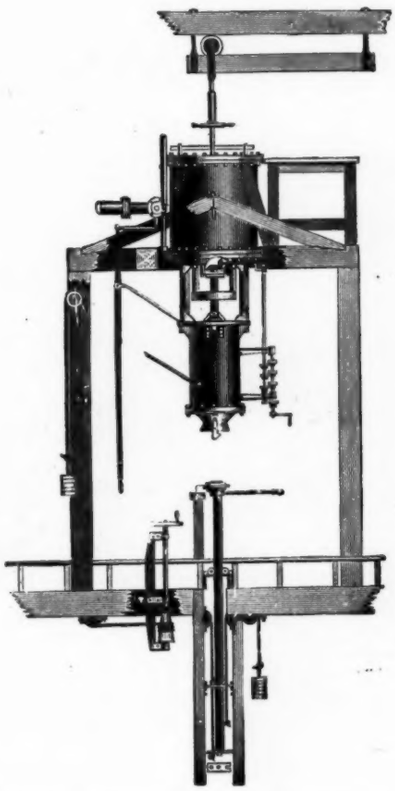

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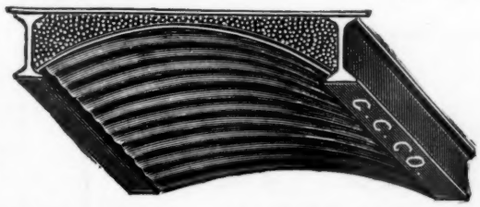

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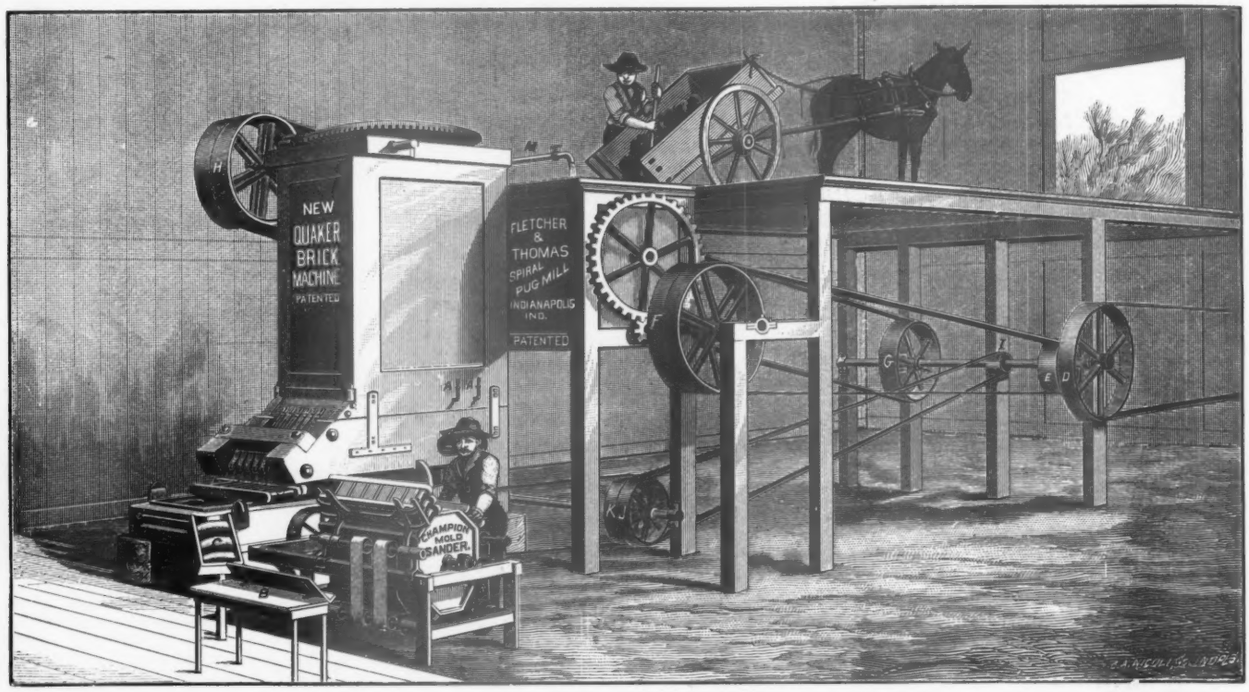

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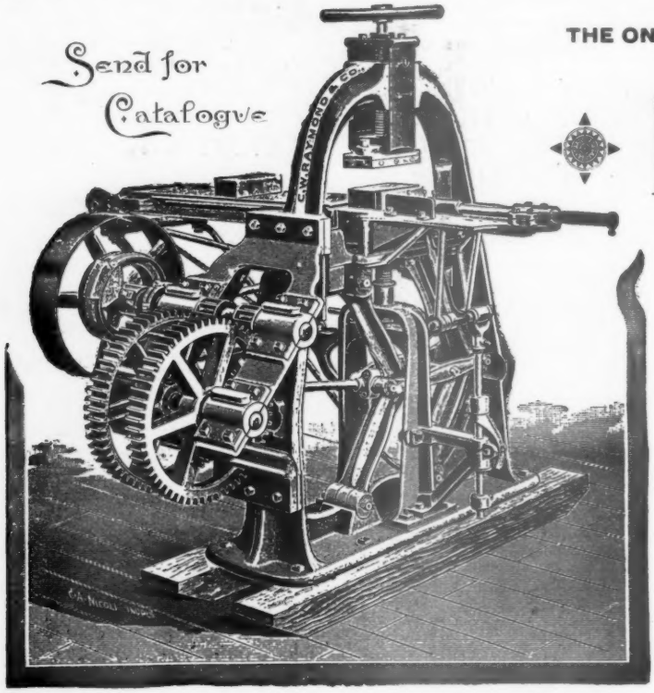

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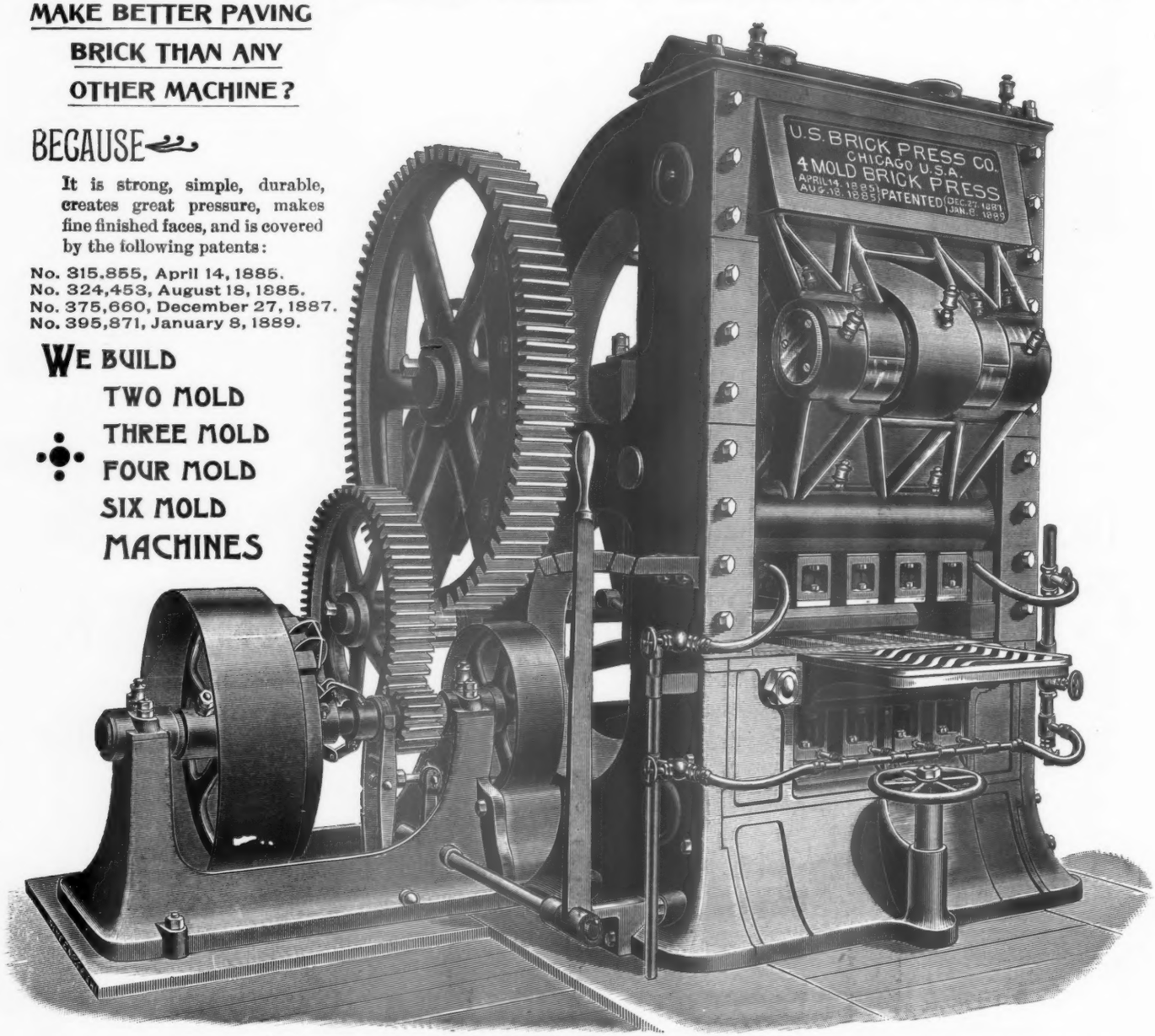

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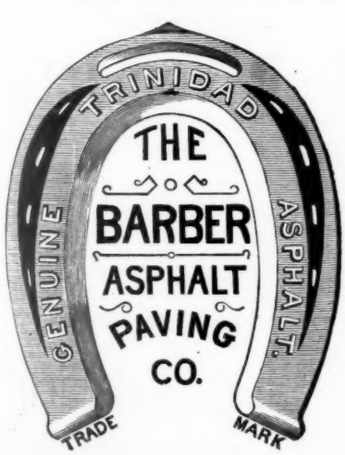

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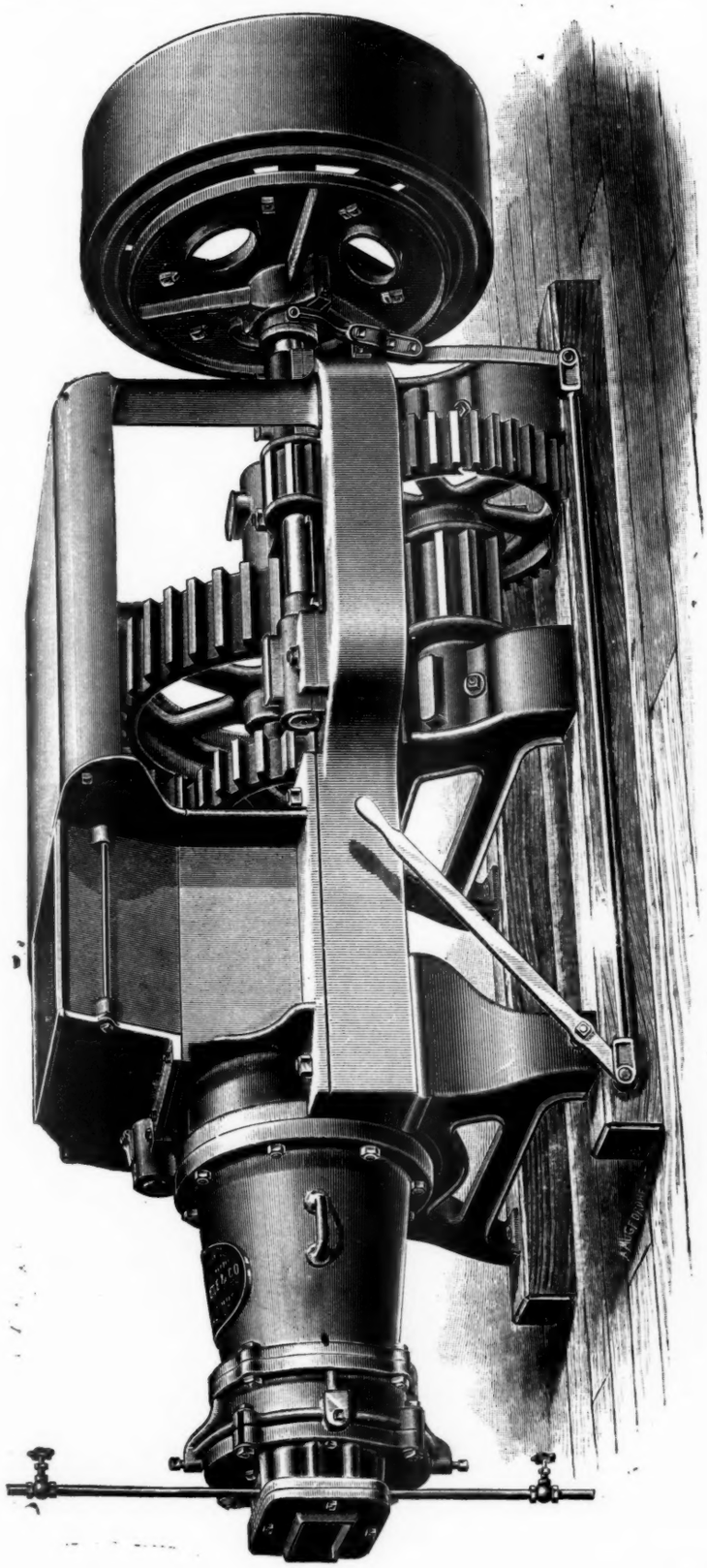

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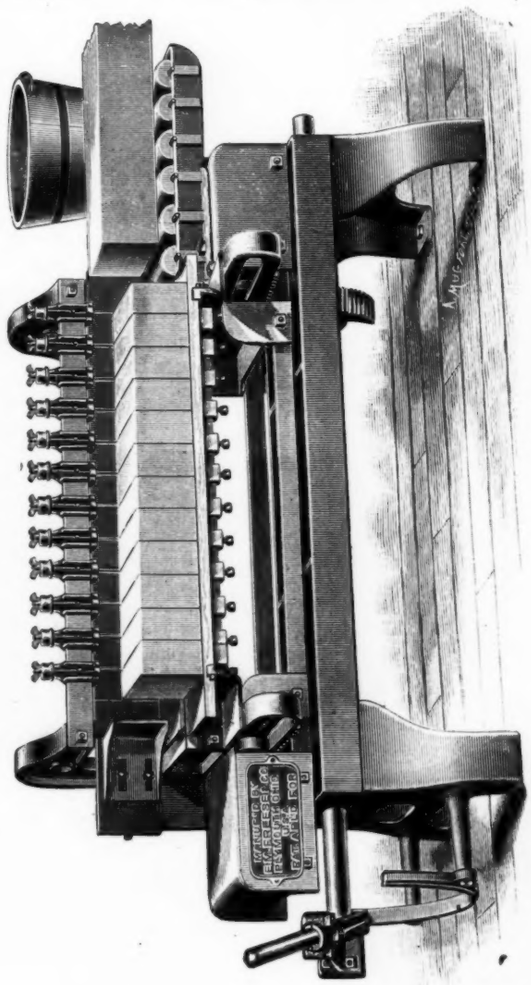

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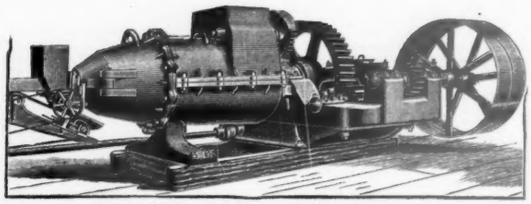

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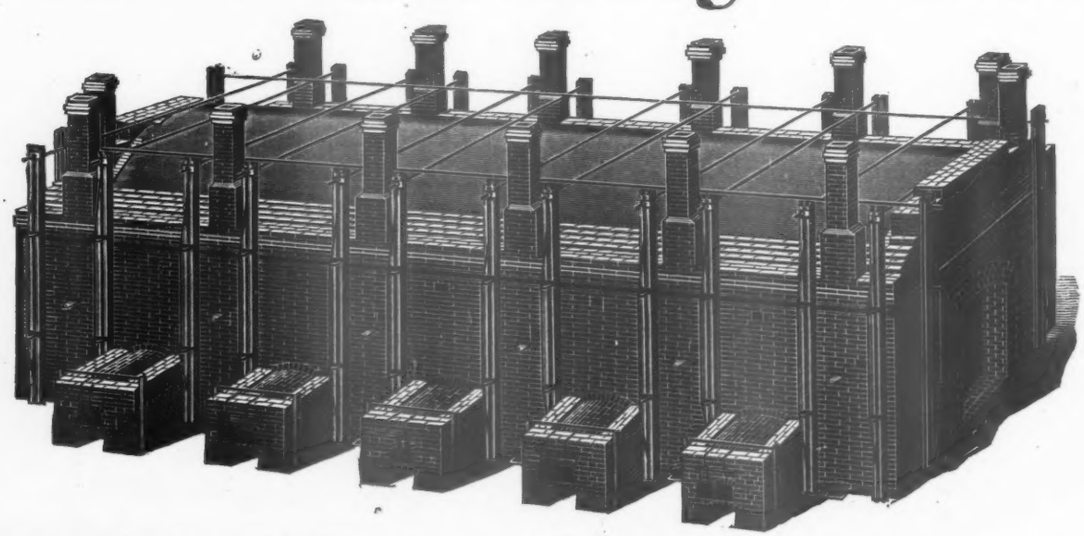

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